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U.S. LONG-TERM ECONOMIC GROWTH PROSPECTS: ENTERING A NEW ERA

A STAFF STUDY

PREPARED FOR THE USE OF THE

JOINT ECONOMIC COMMITTEE CONGRESS OF THE UNITED STATES

JANUARY 25, 1978

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LETTERS OF TRANSMITTAL

JANUARY 23, 1978.

To the members of the Joint Economic Committee:

Transmitted herewith for the use of the Joint Economic Committee and other Members of Congress is a staff study entitled *U.S. Long-Term Economic Growth Prospects: Entering a New Era.*

This staff study appraises the data and interpretations assembled in hearings on *Long-Term Economic Growth*, held in November, 1976, and in 41 research papers on aspects of the subject solicited from recognized experts. These papers have been published by the Committee in a twelve-volume study series entitled *U.S. Economic Growth From 1976 to 1986: Prospects, Problems, and Patterns.*

This stage of the Committee's appraisal of the Nation's long-term economic outlook was begun in 1976 as part of the commemoration of the 30th anniversary of the Committee's establishment by the Employment Act of 1946. This staff study concludes that effort. I believe, however, that it reaches conclusions and raises further questions so significant as to warrant intensive future concern by this Committee as well as by other government bodies responsible for economic policy.

On behalf of the Committee, I wish to thank Dr. Robert Hamrin, Dr. William A. Cox, and other members of the Committee staff for their work in the completion of this study. The views expressed here, of course, are those of the authors and do not necessarily accord with the views of the Committee or its individual Members.

Sincerely,

RICHARD BOLLING,
Chairman, Joint Economic Committee.

JANUARY 19, 1978.

Hon. RICHARD BOLLING,
Chairman, Joint Economic Committee,
Congress of the United States, Washington, D.C.

DEAR MR. CHAIRMAN: Transmitted herewith is a staff study entitled *U.S. Long-Term Economic Growth Prospects: Entering a New Era.* This study presents the staff's conclusions from an extensive appraisal of this subject following hearings and a review of 41 invited research papers on various factors affecting the growth process. These papers were published by the Committee in 1976 and 1977 in a twelve-volume study series entitled *U.S. Economic Growth From 1976 to 1986:*

Prospects, Problems, and Patterns. The staff also has reviewed many other current assessments of the Nation's economic future.

The study concludes that the potential growth of U.S. Gross National Product will decline from its level of about 4 percent per year for the past 15 years to the range of 3 percent by the later 1980s and perhaps less in the 1990s. This decline will be attributable primarily to a drop in labor force growth rates traceable to falling birth rates since about 1960. Also constraining future economic growth are likely to be a decelerating rise in the contribution of higher education; rising real costs of acquiring raw materials; a maturing of major postwar growth industries; and, possibly, shifts in popular values placing less emphasis on economic growth. Working to offset these factors will be technical innovations giving rise to new products and more efficient production processes and a generally faster pace of productivity growth than has been achieved in the past decade.

The Committee's two-year effort to appraise the Nation's economic future has been directed by Dr. Robert Hamrin of the Committee staff. This staff study was drafted by Dr. Hamrin and completed with extensive assistance by Dr. William A. Cox, also of the staff. The heavy burden of preparing the lengthy manuscript for publication has been borne by Linda Maisel, Beverly Park, and Jane Harty. Valuable assistance in preparing the final bibliography was provided by Ken Hughes.

Sincerely,

JOHN R. STARK,
Executive Director, Joint Economic Committee.

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SUMMARY

This staff study attempts to synthesize and appraise information contained in recent hearings and in 41 research papers published by the Committee in a twelve-volume series entitled *U.S. Economic Growth From 1976 to 1986: Prospects, Problems, and Patterns.* Chosen for their diversity, the witnesses and the authors of these papers presented varied and sometimes conflicting views. The following principal conclusions are drawn by the Committee staff based on this and other information at its disposal. Naturally, these conclusions do not necessarily correspond to the views of particular authors.

Any effort to foresee the future is a risky venture. The conclusions presented here, we think, are logical inferences from past trends and current data contained in the research papers and elsewhere. However, they are offered with the knowledge that other, conflicting inferences might be drawn. In the belief that an ounce of prevention often is worth a pound of cure, it is the staff's hope that this effort will engender a debate that in the end will yield some firmer insights into events that lie ahead.

Economic Growth

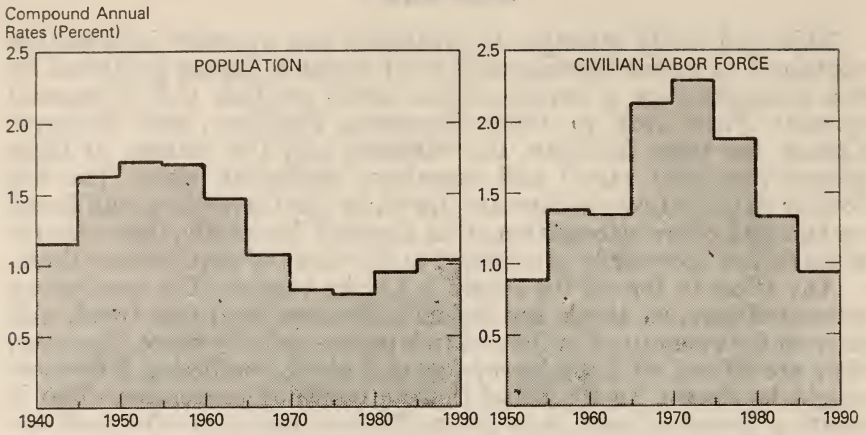
Several participants in the Committee's deliberations stated categorically that *the United States is "entering a new era" in its economic development* with circumstances fundamentally different from those of the past. Among the characteristics of this new era are the persistent slowing of labor force growth foreseen for the 1980's, slower gains in the contribution of higher education, rising real costs of acquiring raw materials, a maturing of major postwar industries, and, possibly, shifts in popular values to place less emphasis on economic growth. Partially offsetting these influences is the prospect of a return to somewhat higher productivity growth through technical progress as the economy recovers and labor becomes more scarce.

Potential GNP (i.e., would-be full employment GNP) has grown over the past ten years at about 4 percent annually. Contributing to this growth has been an exceptionally rapid, 2¼ percent yearly growth in the labor force. To absorb today's backlog of unemployed workers, stemming from fast labor growth under the poor business conditions of the earlier 1970s, the economy must grow at more than 4 percent for several years. Given appropriate policy and an absence of major disruptive events, this should be possible.

Due to the steady decline in U.S. birth rates since 1960, however, *annual labor force growth will fall to less than one percent by the late 1980s.* Figure 1 depicts recent and projected patterns of population and labor force growth. This outlook allows for a further gradual rise in the proportion of women who work. The projected drop in labor force growth could be partly offset by a rise in illegal immigration. Allowing for a small increase in productivity growth as manpower becomes more scarce and costly, *the potential growth of full-employment GNP may be expected to decline from today's 4 percent to about 3 percent per year in the mid-1980s.* Most private forecasters confirm this conclusion.

FIGURE 1

GROWTH PATTERNS OF POPULATION AND LABOR FORCE



Based on population already born, *labor growth will continue declining through the year 2000, reducing potential GNP growth close to the growth rate of productivity itself.* Barring substantial future rises in birth rates or immigration, U.S. population and labor force will virtually stabilize within about 50 years.

It is uncertain, moreover, that labor force participation or working hours will remain as high as now projected. We have seen signs in the past decade especially among the young, that *basic values relating to work are being challenged and in some cases rejected.* This may result in part from relative satiation with material satisfactions at high income levels. It remains to be seen whether such changes in beliefs and priorities will be limited or whether they will be drastic enough to erode the basic growth ethic of modern society. Several participants in the Committee's investigation believe that these "social limits to growth" will be more significant than the limits of natural resources and pollution absorption in constraining the economy's development over the next quarter century.

Thus, the most probable long-term outlook is for slower aggregate economic growth. *The transition to slower growth will influence all phases of the economy, affecting rates of investment, technical progress, and resource use. It will embody many potential sources of social stress,* as will be indicated, and will challenge economic policy as never before. Slower growth need not mean economic stagnation, if these challenges are met with adequate planning and innovative responses. Most experts agree, in fact, that *slower population growth can mean faster increases in per capita income and the quality of life, if the required adjustments can be made without major disruptions.* This is because slower population growth tends to imply a faster increase in the capital-labor ratio and curbs the amounts that have to be invested in expanding infrastructure, pollution abatement, and ever more costly production of energy and raw materials.

Economic Structure

Over the past 50 years, *the economy has evolved steadily from one employed primarily in agriculture and manufacturing into one dominated by service and information-processing industries.* The latter include trade, finance, insurance, education, communications, data processing, and others. In the 1950s, in fact, the Nation passed the point at which one half of the labor force was employed in sectors other than those producing physical goods. This share is now about 65 percent and could rise as high as 80 percent by 1990.

In the 1970s, according to a recent study, employment in "*information-processing occupations*" *across all sectors of the economy reached one half of the labor force.* From 1940 to 1970, in fact, the number of information workers grew at an average annual rate of 3.5 percent, while the total labor force grew at only 1. 4 percent. The role of information and knowledge in the economic process has grown correspondingly. Sociologist Daniel Bell has said that, whereas industrial society relies primarily on energy for the production of goods, a post-industrial society relies heavily on the use of information in production and government.

Since 1970, however, growth in the number of information workers has fallen to the same rate as that of the overall work force. *Some experts believe that the information-handling occupations now are saturated* and will not provide rapidly growing employment in the future. Over the past decade, in fact, new workers have moved primarily into the service sector, particularly into medical services.

During the early 1970s widespread concern arose about the adequacy of capacity to produce and refine basic materials. The steel industry, for instance, projected needs for a 20-percent expansion of its mills by the early 1980s and correspondingly large capital investments. Aside from energy, however, *it now appears that the fear of materials shortages in the early 1970s may have reflected a myopic view of the temporary imbalances existing at that time. In any case, the threat of such shortages has been deflected for the present by subsequent events. The economy has resumed its long-term evolution toward greater roles for fabricating and service industries and slow growth or even decline in many basic materials sectors.*

This process has been accelerated by the effects of fuel price increases on the economics of the energy-intensive basic industries as well as by certain policies adopted to curb energy imports. The largest and most immediate effect on materials markets flows from the reduction in the size of the American automobile, mandated by law to boost its fuel efficiency. The average American-made car has declined in weight by some 15 percent since 1973 and probably will shrink by another 20 percent before 1985. *The auto size reduction and the elimination of lead from gasoline cut a broad swath across the markets for steel, lead, rubber, zinc, glass, and even petroleum.*

A second factor that will limit demands for basic materials in the later 1980s is the gradual decline in new household formation, occurring as a result of declining numbers of young adults, which will continue at least through 1995. As an ever larger share of national income growth results from gains in income per household rather than from growth in the number of households, *consumer demand growth will shift toward outlays for "luxuries," such as more extensive processing*

of goods, leisure activities, services, and custom styling. It should be noted that the slow growth or decline in several basic industries will tend to aggravate the economic plight of the north central and northeastern regions, where these industries to a great extent are located.

Major changes can be expected, of course, in the U.S. energy industries. Even if supplies are adequate, the *refining, transportation and distribution of oil and gas will expand more slowly than in the past and may ultimately stabilize, because the demand for these products will grow slowly. Domestic energy extraction, inexhaustible energy technologies, and energy conservation will be growth industries, however, due to the drive to substitute domestic production for imports. The future role of the capital-intensive electric power sector is unclear.* Its initial response to higher energy prices has been a sharp reduction in capacity expansion plans for the next decade.

The balance of emphasis in national policy between energy production and conservation initiatives is not yet entirely clear. It should be pointed out that most energy production projects require large capital investments but involve relatively few, highly skilled jobs located largely in remote areas. In contrast, emphasis on conservation of energy tends to involve efforts located where people now live with sizeable labor inputs at modest levels of skill.

Labor Force and Human Capital

Growth in the supply of labor and human capital has been a dominant contributor to the economy's growth in the past. The role of this factor will change markedly over the next decade.

One reason for the intractability of the unemployment problem during the 1970s has been the extraordinary rate of labor force growth. *Absorbing the unemployed will be made gradually easier by the fact that labor force growth probably peaked in 1977 and will undergo a long and steady decline* as the large number of persons born in the 1950s are followed into the labor market by the ever smaller cohorts born during the 1960s and early 1970s. Also affecting the frequency of unemployment will be the fact that the labor force will contain a smaller number of teenagers and young adults, who are more prone than older people to change or leave their jobs, and a correspondingly larger share of prime-age workers.

This radical change in the labor force growth rate will bring equally radical changes in the nature of policy problems facing the Nation. *Barring further major disruptions that prevent normal economic growth, today's labor surplus gradually should give way to labor scarcity, except in sectors and regions with heavy structural unemployment.* It will become more difficult in many areas to fill all types of unskilled and low-wage jobs; many such functions will disappear and others will be automated, boosting average labor productivity. The reduced number of young people will mean fewer workers available for all types of entry-level jobs, including those in the military forces. It will make recruitment more difficult for expanding firms and industries. The lower mobility of an older population will slow the migration from the Northeast to the South and West. Within a few years employers, especially in these latter regions, will have to mount efforts to seek out and train persons willing to work. They also will

have to entice workers by offering more flexible working conditions and more part-time work. Labor scarcity will help to absorb today's underprivileged minorities into the economy. The greatest beneficiaries of a tighter labor market would be today's marginal worker: the unskilled, the older worker, the part-time worker, and of course the unemployed. Labor scarcity may also place immigration issues in a new light.

Against the background of overall labor scarcity, especially at the low-wage end of the spectrum, some *under-employment of college-educated manpower is likely to persist.* The continuing rise in the high postwar rate of college attendance among the swelling ranks of student-age persons since 1965 has catapulted the college educated fraction of the labor force from about 10 percent in 1960 toward a projected 20 percent by 1985. Meanwhile, the number of jobs for college trained people has lagged behind the supply of graduates. A strong case can be made that today's glut of young graduates will not be completely absorbed even by several years of recovery from recession.

The result of such an oversupply is not unemployment for college graduates but rather a process of "bumping" some people down the ladder of job status. This market congestion, moreover, will not alter the outlook for eventual overall labor scarcity, because college-educated personnel comprise less than 20 percent of the labor force, and the actual surplus of such personnel by 1985 might be only 1 or 2 percent of the total. The oversupply, however, already is suppressing the monetary returns from college education. Moreover, it will not be possible to invert the job status pyramid in the 1990s as the age pyramid of educated personnel becomes inverted. Many of today's young graduates, therefore, will meet disappointment in their aspirations for advancement. This "clot" in the age structure of the highly educated will mean relatively few opportunities for new graduates through the year 2000. Such compression of pay differentials and disappointment of job aspirations could result in a sharp decline in college going by young people in the 1980s and could comprise a major source of social discontent, unless steps are taken to utilize the productive potential of college-educated workers more fully.

Capital Formation

There has been much concern in the past several years about potential shortages of investment capital to expand capital-intensive basic industries. These fears were greatly aggravated in the 1973–1975 period by rapid inflation combined with recession and tight monetary policies. The conditions that gave rise to them now appear to have resulted largely from the severity of those cyclical conditions. The continuing underutilization of resources at present indicates an excess of national savings over desired investment, despite the role of the Federal budget deficit (dissaving) in offsetting some of this excess. The prevalent view among independent economists is that *no pervasive shortage of investment funds is likely barring a sustained investment boom extending into the 1980s.*

The present deficiency seems to be one of projects to utilize available investment capital in the private sector. Many explanations for the slow growth of investment have been put forward. The fundamental

problem, however, is the fact that the economy has required more than three years to regain its 1973 production levels, and the remaining life of this business expansion is uncertain. New fears of potential energy supply reductions and further price hikes add to caution about the longer-term business outlook. Furthermore, questions discussed above about the long-term development of demand in many industries may already be playing a role, particularly in the lag in investment in electric generating capacity, steel, and several other basic sectors.

Most analysts agree that *the fraction of GNP going to business investment over the next several years must be somewhat higher than in the past decade* if the Nation's goals for employment, productivity, domestic energy production, pollution abatement and healthful working conditions are to be fulfilled. Most agree that *this rate of investment is within reach and within the range of past experience* at times of full employment and steady economic growth.

Certain capital-intensive industries—aluminum, plastics, and telecommunications—can be expected to grow as fast as the economy or faster. Many fabricating and service industries should do likewise. Both private and public investments in energy production and conservation will grow rapidly. Other basic industries, as indicated, will expand less rapidly than recently thought. In industries for which final demand is projected to level off or decline, investment activity will reflect this outlook in advance of the actual leveling, because of the long gestation and pay-off periods of major industrial facilities. An interim tendency toward shortages of capacity in some of these sectors could result.

Some attention has been focused recently on the possibility of long waves in investment and thus in economic activity. Proponents of this thesis suggest that the burst of economic growth since 1946, instead of being traceable mainly to modern stabilization policies, was carried forward by a wave of investment and innovation backlogged during two decades of depression and war. They assert that this growth performance is not sustainable and will give way to a period of relative economic stagnation. They point to investment cycles of 50 years or more in earlier periods of economic history. It is clear that a wave effect occurred after World War II, and this compounded with other influences sustained the postwar economy. It is hard from this vantage point to discern the extent to which the sources of this remarkable growth period now have run their course.

To the extent that doubts about future markets underlie investor hesitancy, it is questionable that new corporate tax incentives will substantially boost investment. It should be recognized, moreover, that corporate fixed investment is only about one-sixth of national capital formation, broadly defined, and it probably should not be favored over other types of investment (e.g., human capital, research and development, unincorporated businesses, and residential capital).

In examining the oft-stated view that a lower U.S. investment rate accounts for the fact that this nation has achieved only a modest rate of economic growth compared to many other countries, it was found that the data do not conclusively show less U.S. investment *in real terms*, because the *prices* of capital goods have been lower here compared to other components of GNP. It also was pointed out convincingly that investment has been only one among several variables

explaining international differences in growth rates and by no means the most important.

The long-run outlook for savings requires clarification. The number of persons of middle age, who save the most, will decline over the next decade. On the other hand, the increasing prevalence of multiple earners per household and generally rising household incomes may permit the average personal savings rate to remain at an adequate level. Corporate saving recently has been recovering from its low point of the earlier 1970s through rapidly rising capital recoupment allowances, and a reduction in corporate income taxes, if enacted, will help it to rise further in the future.

In any event, *there is considerable scope for the government budget to equalize national savings with investment* by offsetting the imbalance between them in the private economy. This is a crucial government function. The Congressional Budget Act, in force since 1976, requires Congress to review the overall budget twice every year and to hold to the resulting budget resolutions, enabling Congress to serve this objective much more effectively than in the past. However, *Congress should consider more decisive shifts in budget policy in response to changing economic conditions than it has undertaken in the past so as to realize the full potential of its powers to maintain balance in capital markets and the national economy.*

Natural Resources

Known sources of mineral raw materials are adequate to satisfy global demand for the next 10 years. Even in the case of oil, it is *political* action affecting supply and prices that is the serious concern for this period. As noted above, excess capacity in certain minerals processing industries may be a problem in the United States in the 1980s.

In fact, *most economists expect nature's bounty of most materials to be sufficient for at least several decades*, although supplies of lead, zinc, and copper may be seriously depleted by the end of the century. Many geologists, however, are less sanguine about the longer run. One predicts global shortages of antimony, bismuth, copper, gold, and molybdenum within 50 years, plus global exhaustion of oil and gas; and forecasts that the energy costs of refining various materials from ever lower ore grades will place limits on their use. In any case, the *U.S. will become increasingly dependent on imported minerals, as other industrial countries long have been.*

Natural resources economics depends on a perpetual race between resource depletion and technological progress in minerals production. Throughout the industrial era, technology has won this race, but this may not always be the case. World demand will escalate quickly, as the impoverished four-fifths of mankind strives toward the materials-intensive living standard now prevalent in the advanced countries. If depletion begins to outstrip technology, resulting in falling productivity and short supplies in extractive industries, then materials will become relatively more costly in the production process, exercising some drag on economic growth.

Even in this case, however, *rising raw materials costs can be offset* through designing for greater durability and ease of repair, reducing scrap in production, and recycling discarded items. In addition, it

often will be possible to substitute other materials for those becoming scarce and costly.

Major innovations conserving or substituting for scarce materials are complex processes often dominated by the unforeseeable course of technical progress, as in the cases of solid-state electronics and microwave communications. Such innovations typically require a generation for commercialization and diffusion into the market. Other, less fundamental technical improvements take place more quickly. In addition, capital and labor also can be substituted for materials by installing more efficient production equipment, more careful monitoring of materials use, and conservation devices. Exploitation of these possibilities may stimulate a new cycle of investment in energy and materials-intensive industries in the years ahead.

A look at energy-GNP relationships in other countries indicates that the United States could be far more efficient in energy use with known and proven technology. New incentives have bred a wave of research that doubtless will develop new conservation techniques. Most experts agree that *the U.S. can adapt over time to much slower or even zero growth in energy demand without sacrificing comfort or a vigorous economy.*

Whatever the outlook for the next few decades, it is clear that the earth's endowment of natural resources is *ultimately* finite. Sooner or later, human population and living standards will be reduced in some manner, unless our descendants escape the limitations of the planet in obtaining minerals and energy. Until such an escape is devised, *the present generation has a moral obligation to future mankind to conserve in our uses of natural resources.*

Productivity and Technological Change

Productivity gains are the primary source of rises in per capita income. Since 1966, these gains have proceeded more slowly than during the first 20 postwar years. This has been attributed to various causes: (1) the large influx of inexperienced workers into the labor force; (2) lower capacity utilization; (3) increased government regulation; (4) the declining share of GNP devoted to research and development; (5) inherent limits on the scale, speed, and energy efficiency of machine processes; (6) adverse changes in popular attitudes; and (7) shifts in the economy toward service sectors. Up to one-third of the slowdown has been traced to the changes in labor composition and another one-third or more to poorer use of capacity.

Future productivity gains are expected to accelerate again from the slow pace of the last decade. Indeed, a return of steadier growth and greater economic confidence could release a wave of innovations backlogged during the recent years of poor business conditions. The decline in labor force growth foreseen for the 1980s will spur labor-saving innovations. Besides reduced labor supply growth, the age composition of labor will change with today's large group of young workers moving into their most productive years. Increased energy and materials prices also will accelerate replacement of old equipment as well as spurring substitutions such as those of communications technologies for transportation, and recycled for virgin materials. On the other hand, productivity may be hampered in regaining the fast pace of the earlier postwar period by the declining quality of domestic

natural resources, the slowdown of advances in education, and the lag in research and development.

A large proportion of the productivity gains is contributed by advances in technology itself. It has been the past pattern, in fact, for new industries based on technical breakthroughs—such as petrochemicals and electronics—to lead the economy's growth. Some observers question whether new processes and product innovations with mass markets will continue to arise at the same rate as in the past. Others believe that major technical advances will continue, especially in electronics, automation, information handling, food, and biological manipulations. Driving these changes will be the fundamental shifts in energy and materials availability as well as the broadening role of science as a well-spring of innovation. Other suggested possibilities are innovations in what have been termed social and intellectual technologies, such as the size and organization of institutions, the organization of work processes, and methods of enhancing the effectiveness and satisfaction of human beings. As in previous periods, many novelties will evolve that are not presently anticipated.

In any case, government should reevaluate its policies toward research and development. It is clear that basic science, being unpatentable, is largely a public responsibility. It also is clear that research institutions are languishing financially, while highly trained technical personnel are in excess supply and could be used in part to spur U.S. technology.

Some recent evidence even indicates that the very large social returns from innovation outside the confines of the innovating firms may provide a strong rationale, heretofore unclear, for broader public support of commercial technology development and innovation. This kind of approach now has been adopted on a large scale for energy technologies. However, one must find means to overcome the fact that prospects of public funding tend to suppress privately financed efforts.

Several observers have pointed to the fact that the largest research and development efforts and results emanate from small and medium-sized firms. Large firms, often founded by innovators, come under professional management and become less willing to take risks. Indeed, large firms with dominant market positions have less to gain and more to lose through innovations that may supplant their existing products or processes. This provides another reason for government to consider ways to foster small, innovative firms, for instance by facilitating their access to capital.

The United States and the International Economy

From 1950 to 1972, world trade grew nearly 50 percent faster than world production. The ratio of U.S. imports and exports to gross domestic product has risen from 9 percent in 1951 to 15 percent in 1974. The interdependence among nations has been made clear lately by widespread emphasis on the need for international cooperation in sustaining the recovery from the 1975 recession.

In the past, U.S. economic growth has been positively correlated with that of other countries because of the role of U.S. markets for their exports. However, since the rapid rise in U.S. dependence on foreign oil, beginning in 1974, strong U.S. growth also has the effect

of raising oil imports and threatens within several years to create supply and price pressures in the international oil market. Such stringency would have a negative effect on the trade balances and growth of other countries.

United States growth policies will be more important to the less developed countries than to other industrialized countries which, with the exception of Canada and Japan, trade more extensively among themselves than with the United States. On balance, the effect on less developed countries of faster U.S. growth will be positive because of the importance to them of expanding markets for manufactured exports and of averting the tendency toward protectionism that accompanies slow growth.

Despite increasing dependence on foreign suppliers, the United States still is in a stronger position than almost any other industrial country with regard to raw materials. It has large strategic stockpiles of most nonfuel minerals that are heavily imported. Even with energy, the United States is relatively less dependent. Experts agree that cartelization or supply cutoffs of nonfuel minerals are unlikely and, in any event, would not seriously harm the United States within a plausible period of time. *Nonetheless, top priority should be placed on the design of an energy policy that will mitigate the U.S. impact on the international oil market,* because potential conflict over energy is the primary threat to good relations among the industrial countries.

The United States can expect increasingly intense competition from other manufacturing countries in the world economy. This competition will be a major stimulus to the efficiency of U.S. industry. A resort to protectionism would permit U.S. industries to avoid needed efforts to boost productivity.

I. INTRODUCTION

In 1975 the Joint Economic Committee launched a comprehensive examination of the long-run prospects of the United States economy and the forces bearing upon them. This endeavor, the findings of which are summarized in this staff study, was the third successive mid-decade examination of the Nation's long-run economic potential by the Committee since it was established in 1946.[1]

Great changes have occurred in the past decade in the conditions for economic development, and more can be foreseen. Some of these, such as the slowing of population growth, the sharp rise in energy prices, and the spread of environmental regulations, can be documented and measured. Others, such as changes in personal values, institutional responsiveness, and in the capacity to innovate, are less tangible. They may be described and projected qualitatively but not easily measured. Yet the latter kind of development may be as important as the more readily measurable kind for the Nation's economic future.

Some observers claim that the United States has "entered a new era" in the past decade which differs fundamentally from the period before. Several participants in the Committee's series of studies and hearings stated this view. For instance, Professors Allvine and Tarpley of the Georgia Institute of Technology wrote in a monograph for the Committee:

> In the late 1960s and early 1970s certain fundamental conditions supporting an expanding economy changed, and the economy has now entered into a new era. The problems and prospects are quite different in the economy of the 1970s.[2]

Professor Ronald Müller of the American University formulated the matter similarly:

> . . . the post-World War II economy of the United States has undergone a fundamental structural transformation. . . .
>
> The U.S. economy in its post-bicentennial era is radically different . . . the turning point in transformation . . . is estimated to be between 1965 and 1968.[3]

Professor Burkhard Strumpel of the University of Michigan stated:

> Most of the basic coordinates governing the present situation differ in important respects from those prevailing in the postwar period.[4]

The proposition that America faces fundamentally new conditions in its economic development has been supported by other authorities, including Carl Madden and Willis Harman, who participated in the Committee's investigation. Arthur Johnson, a historian who has devoted his career to studying the relationship between social and economic change, wrote recently:

> The Nation is clearly in a state of transition that challenges assumptions about the organization and goals of economic activity . . . It may well be that we are

[1] JEC Staff Study, "Potential Economic Growth of the United States During the Next Decade," October 1954 and "U.S. Economic Growth to 1975: Potentials and Problems," 1966.

[2] Allvine and Tarpley, p. 46.

[3] Müller, p. 35.

[4] Strumpel, p. 38.

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entering one of those periods of great discontinuities comparable in the history of Western civilization to those of the Renaissance and Reformation.[5]

Indeed, President Ford, in his 1976 Report on National Growth and Development, recognized that a host of "new realities" impinge on future growth prospects. These include the new geopolitics of resource supplies, the stronger inflationary bias in the world economy, and the uncertainty about the adequacy of long-term capital supplies. The report concluded:

> These new realities have altered long held assumptions concerning the inevitability of growth and the rate at which living standards will rise from generation to generation over the years ahead. . . . Future expectations are far more moderate today than they were a few short years ago. . . . This new outlook is not transitory but reflects deep-rooted changes in perceptions concerning the place of the U.S. within the world community and the finiteness of the planet's wealth of land, water, and mineral resources.[6]

This change in perceptions and in the conditions governing the economy dictated that the Committee's current examination of U.S. economic prospects adopt an approach going beyond the numerical projections that characterized its efforts in this field in the 1950s and 1960s. In response, the Committee brought together some of the best informed observers of the factors feeding into the economic process: population and labor, capital, technology development, social and institutional forces, natural resource supplies, and influences stemming from the international economy. A number of persons who have challenged the convention wisdom in these fields were invited to contribute papers on specific topics. The same topics were treated in many cases by authors with other, often more traditional views, so that these arguments and modes of analysis could be compared and evaluated. In most cases, it was found that insights from both viewpoints are valuable and necessary to a balanced picture of the economy's potential course. Because economic developments are influenced by many factors not within the purview of conventional economics, the perspectives of other disciplines also are essential to a well rounded picture. Thus, more than one-third of the authors have backgrounds in fields such as geology, physics, chemistry, systems analysis and political science.

In all, some 41 research papers on specific topics related to economic growth prospects were received from leading experts in various disciplines. These have been published in a 12-volume series entitled *U.S. Economic Growth from 1976 to 1986: Prospects, Problems, and Patterns.* A list of these authors and papers appears as the first section of the comprehensive bibliography at the close of this study.

In November 1976, the Committee held hearings on long-term growth prospects with testimony from some of the persons contributing research papers as well as other witnesses. This staff study comprises an evaluation of material generated in the invited papers and the hearings. In preparing this report, the staff also has reviewed many other recent contributions to the debate on U.S. growth prospects (see bibliography).

Thus, this evaluation reflects a much broader concept of economic growth than simply the rate of increase in output per head. The econ-

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[5] Arthur M. Johnson, "The Business of America—Does It Face A Period Of Basic Change?", p. B1–B2.

[6] The Committee on Community Development, and the Domestic Council, "The 1976 Report on National Growth and Development," pp. I–2 & I–3.

omy's long-term development is examined in its relationship to the larger context of social, physical, and technological forces. As Carl Madden states in his paper for the Committee: "Modern economic growth represents an irreversible process of cultural and social, as well as economic, transformation." [7] Thus, industrialization has brought urbanization, increases in the scale of organizations, changes in the family, and changes in patterns of international dependence, with all the further ramifications of these developments.

This report also recognizes the fact that growth in GNP is not necessarily the same as growth in national economic welfare. Although the United States economy has attained annual growth rates of three to four percent in real terms during much of the twentieth century, and though it provides a high material living standard for the average family, it still fails to satisfy many people's needs and desires. Some citizens still do not have adequate food and shelter. Many others, despite adequate incomes, lack the fulfillment of meaningful and challenging jobs with prospects for variety and advancement. Furthermore, economic growth is not a pure "good," because it creates a need for "defensive" expenditures on such things as pollution abatement, environmental restoration, and noise control.

These facts lead one to conclude that it is not only the *quantity* of output but also its distribution and the manner in which it is produced that determine whether the economy fulfills the needs of the people who participate in and depend upon it. The objective of policy, therefore, should be to maximize national economic *welfare*, defined to take account of pollution, resource depletion, the quality of work, income distribution, and other aspects of welfare not reflected in GNP as now calculated. The problems of measurement clearly are great both for GNP and for broader gauges of national welfare (see appendix to this study). When issues are placed in this context, however, the question of growth versus no growth (or more versus less growth) should become more tractable, and a more fruitful dialogue about the kinds of growth that best serve the national welfare should be possible.

Chapter II will address some of the broader social developments discerned by various observers, including the growing predominance of the service and information-producing sectors, changing attitudes toward income and work, and the allegedly declining adaptability of institutions. Chapter III projects the anticipated effects of slower population growth on the development of the labor force and thereby on aggregate and per-capita income growth. It also examines the education profile of the work force and the new problem of widespread "overeducation." Chapter IV deals with the recent experience and projected needs of investment and saving and the role of tax incentives as well as the overall balance of the Federal budget in creating an environment conducive to capital formation. It disposes of the belief that higher investment rates in other industrial countries are an important reason for more rapid economic growth there. Chapter V then delves into questions of natural resource scarcity and how they may be met in the medium as well as the long term. Chapter VI is concerned with the prospects that productivity growth will return to the pace it attained in the earlier postwar period and the future role

[7] Madden, p. 9.

of technology in achieving these gains. Chapter VII examines the interrelationships between U.S. economic growth and that of developed and developing countries abroad. Chapter VIII provides a review of quantitative growth projections for the coming decade as well as some comments on how to achieve more optimal growth.

In anticipating the questions of those who doubt the possibility of saying much of value about the long-term future in view of the uncertainty involved, it is fitting to cite a comment contained in the Committee's 1966 staff study:

> First, it is actually easier to detect long-run, enduring trends and structural relationships in the economy than it is to discover procedures for forecasting short-term fluctuations. In the long run, the more enduring structural characteristics of the economy dominate.
>
> Second, long-run projections provide a frame of analysis that enables us to reason in orderly fashion about the more enduring structural and persistent tendencies in the economy which dominate in the long run. As we come to understand better these long-term forces and how they operate, we improve our knowledge of the sources of temporary short-term departures from these longer run trends.
>
> Third, policy actions taken in response to short-range developments have a tendency to produce persistent and enduring effects for many years into the future. A thorough understanding of the longer run tendencies and the problems of maintaining the upward thrust of the economy over long periods are an essential precondition to correct decisionmaking in the short run.[8]

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[8] "U.S. Economic Growth to 1975: Potentials and Problems."

II. SOCIAL FORCES BEARING ON ECONOMIC GROWTH

It is clear that an analysis based on economic variables alone will yield an inadequate understanding of the course of economic events and the proper ways to deal with them. Wassily Leontief placed economics into its broader context in his statement before the Committee's November 1976 hearings on long-term growth:

> Most of the difficult problems confronting the country—energy, environment, natural resources—are partly economic, partly technical, partly social. The conventional distinction between economics, engineering, geology and even biology gradually disappears.

This chapter tries to assess the potential effect on U.S. economic development of several of the less readily measurable but potentially powerful factors toward which various commentators have directed recent attention. These include the following:

(1) The increasing role of information and knowledge as economic resources;

(2) People's changing personal values and priorities;

(3) Increasing social and technical complexity that challenge management and government;

(4) Increasing institutionalization and rigidity of interest group demands; and

(5) Long waves in economic activity.

Widespread agreement exists on the significance of the first two of these phenomena. The first of them has broad implications for the sectoral balance of future growth and the resulting economic structure. The other four factors, to the extent that these observations are valid, threaten to slow the Nation's economic growth as it is traditionally defined.

The Increasing Role of Information and Knowledge

The most salient characteristic of the Nation's pattern of economic growth in recent decades has been the evolution into a service-information economy. The phrase, "service-information economy," describes more precisely what is meant by the popular phrase, the "post-industrial society." The U.S. socioeconomic system has evolved in this direction over a long period with far-reaching implications not only for economic affairs but also for the structure and governance of society. This evolution is expected to continue.

The role of service and information industries in the so-called "post-industrial society" is evident from the list of attributes characterizing this concept formulated by Daniel Bell, its originator:[1]

The change from a goods-producing to a service economy;

The preeminence of the professional and technical class;

The central role of theoretical knowledge as the source of innovation and policy formulation;

The creation of a new "intellectual technology;" and

The possibility of a self-sustaining technological growth.

[1] Daniel Bell, "The Future of the Corporation," p. 18.

The first of the above mentioned attributes of the post-industrial society is easily substantiated by a few facts. In the 1950s, the economy came to rely dominantly on the service sectors for employment, when for the first time the nongoods-producing industries came to employ more than half of the labor force. Between 1950 and 1974, barely more than 1 million of the 27 million additional jobs were located in goods-producing industries, i.e., agriculture, mining, manufacturing, and construction.[2] Although early in the century only 3 of every 10 workers were employed in service industries, by 1970 it was 6 out of 10; by 1980 it will be 7 out of 10, and by 1985 it could well be 8 out of 10. We are fast approaching the time when only 20 percent of the labor force will produce all of our agricultural and manufactured goods. As far as factory production jobs themselves are concerned, by 1976, fewer than 14 million of more than 87 million employed persons worked in such jobs.[3]

Reference to the rise of the services sector often conjures up visions of a labor force consisting mainly of personal service workers, such as waiters and hair stylists. In fact, conventional service occupations such as these have comprised a steady 15 to 25 percent of the labor force for a hundred years, according to a recent study by Marc Porat.[4] Though their growth since 1960 has exceeded that of the economy as a whole, the most dynamic force underlying the broad development of the service economy has been the growing role of information workers and the related impact of new knowledge and information on the economy. Daniel Bell has asserted that, whereas an industrial society is organized primarily around energy and the use of energy in producing goods, "a post-industrial society is organized around information and utilization of information as a way of guiding the society." [5] John McHale, in his paper for the Committee, stressed the unique characteristics of information resources, which are not reduced or depleted by wide distribution and use as are other resources. They tend rather to gain in the process. Unlike depletable mineral resources, information and knowledge are inexhaustible.

Porat attempts to lend empirical substance to the previous, largely conceptual literature on the post-industrial society. He defines information workers as those whose functions consist primarily of the manipulation of symbols and information. Thus, information workers exist in most sectors of the economy, including the industrial sector. This category, however, does not encompass the conventional service workers in the traditional service industries.

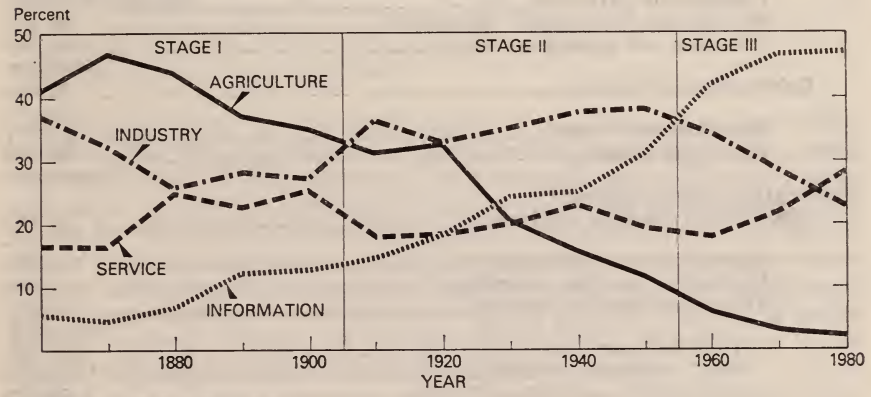
Figure II–1 delineates three stages in the evolution of the U.S. labor force. Agricultural workers outnumbered other major categories until 1905, relinquishing their dominance to industrial workers who re-

[2] Edison Electric Institute, "Economic Growth in the Future," p. 79.
[3] The Wall Street Journal, "The Outlook," March 1976.
[4] Marc Porat, "The Information Economy," p. 123.
[5] John McHale, "The Changing Information Environment," p. 61.

mained the largest group for 50 years. By 1955, information workers had become the dominant category. Over the long run, the information workers, thus broadly defined, have gone from less than 10 percent of the total labor force in 1860 to more than one-half of the labor force in 1975. In 1940, the information work force was about half the size of the industrial work force, while today the situation is reversed. From 1940 to 1970, the number of information workers grew at an average annual rate of 3.5 percent, while the total labor force grew at only 1.4 percent.

FIGURE II–1

FOUR-SECTOR BREAKDOWN OF THE U.S. WORK FORCE, 1860 - 1980 (PERCENTS)
USING MEDIAN ESTIMATES OF INFORMATION WORKERS



Source: Marc Porat, *The Information Economy.*

In terms of employee compensation, the rise to dominance of the information worker occurred eight years earlier, because information workers earn higher average incomes. By 1967, information workers received 53 percent of the total compensation. Table II–1 indicates the various classes of information workers identified in the Porat study and shows their aggregate compensation for 1967.

Porat defined as the "primary information sector" those firms and other institutions producing information goods and services for sale in the market. The "secondary information sector" is defined to include information services produced for internal consumption by government and noninformation firms. He found that 25 percent of 1967 value added originated in the primary information sector, while 21 percent of value added originated with the provision of secondary information services. Thus, in 1967, the total information activity accounted for 46 percent of the GNP. This fraction is less than the information workers' share of employee compensation because of the labor and skill-intensive nature of information industries.

TABLE II–I.—*Typology of information workers and 1967 compensation*

	Employee compensation (millions)[1]
Markets for information:[2]	
Knowledge producers	$46,964
Scientific and technical workers	18,777
Private information services	28,187
Knowledge distributors	28,265
Educators	23,680
Public information disseminators	1,264
Communication workers	3,321
Information in markets:[3]	
Market search and coordination specialists	93,370
Information gatherers	6,132
Search and coordination specialists	28,252
Planning and control workers	58,986
Information processors	61,340
Nonelectronic based	34,317
Electronic based	27,023
Information infrastructure:[4]	
Information machine workers	13,167
Nonelectronic machine operators	4,219
Electronic machine operators	3,660
Telecommunication workers	5,288
Total information	243,106
Total employee compensation	[5] 454,259
Information as percent of total	53,520

[1] Includes wages and salaries and supplements.
[2] Includes workers whose ouput or primary activity is an information product.
[3] Information in markets includes workers who move information within firms and within markets—they search, coordinate, plan and process market information.
[4] Includes workers who operate the information machines and technologies to support the previous two activities.
[5] Excluding military workers.

Sources: Computed using BLS occupation by industry matrix, census of population average wages. See appendix 6 for the full employee compensation matrix and a narrative on how it was produced; and Marc Porat, "The Information Economy."

As seen in Table II–2, the astonishing growth in the number of information workers since 1860 was far from steady over time. Since 1970, in fact, the number of information workers has expanded at about the same rate as the overall work force. This may imply a saturation of the information work force. Over the past decade, new entrants to the labor force have moved primarily into the traditional service sectors with a particularly heavy inflow into medical services. The growth in the absolute number of service workers today is almost equal to that of information workers. *Porat, in fact, concluded that the potential for future growth of the information work force is limited:* "As of this decade, the private and public bureaucracies are glutted with information workers. No more can be easily absorbed."

TABLE II-2.—COMPOUND ANNUAL GROWTH RATES OF INFORMATION WORKERS AND TOTAL LABOR FORCE

[In percent]

Period	Information workers	Total labor force	Difference [1]
10-yr periods:			
1860–70	2.26	4.21	−1.95
1870–80	6.53	3.35	3.18
1880–90	9.57	2.72	6.85
1890–1900	2.84	2.51	.33
1900–1910	4.74	3.16	1.58
1910–20	3.06	1.30	1.76
1920–30	4.55	1.21	3.34
1930–40	.64	.48	.16
1940–50	2.94	.77	2.17
1950–60	4.80	1.60	3.20
1960–70	2.69	1.68	1.01
1970–80	1.85	1.81	.04
Recent experience:			
1940–60	3.87	1.18	2.69
1960–80	2.27	1.74	.53
The long term: 1860–1980	3.85	2.06	1.79

[1] Growth rate of information workers minus the growth rate of the total labor force.

Source: Marc Porat, The Information Economy, 1977.

This projection for the information work force does not mean, however, that the importance of information processing in the economy will wane. On the contrary, the United States will become more and more a service-information society over the next decade. The reason for this contrast between employment prospects and the sector's future role in the economy is that production processes for many services are changing radically. Many traditional direct personal services and "paper-pushing" activities will rapidly become obsolete. A study by the Research Institute of America entitled *What To Expect in the Next Ten Years* described the dramatic shift succinctly:

> Tomorrow's capital-intensive service industries will include not only highly computerized financial institutions, but automated public transportation, electronically controlled communications, virtually unattended personal services facilities such as laundry and dry-cleaning, car washes, fast-food dispensing, and so forth. The common element of all of these examples is that they will involve heavy capital investment and relatively little manpower, and all will provide markets for the sophisticated products of high-technology manufacturing industries.[6]

While the slower growth of labor-intensive information services and the automation of traditional service industries may make it more difficult to absorb existing unemployment in the short run, they will be in accord with the longer-term needs of an economy with a much more slowly growing labor force, as we shall see in Chapter III.

Emphasizing that the service industry will be the fastest growing economic sector over the coming decade, this study also noted that services associated with information processing in all its forms will be among the leaders. Daniel Bell has coined the phrase "intellectual technology," referring to such techniques as linear programing, systems analysis, information theory, decision theory, game theory and simulation, which he expects will extend our intellectual powers

[6] Research Institute of America, "What to Expect in the Next Ten Years," p. 244.

enormously. He maintains that the emergence of a new intellectual technology by the end of this century may be "as decisive in human affairs as the machine technology has been in the past century and a half." [7]

McHale contends that future patterns of wealth and power will depend more on the exploitation of "information as a resource" and will be less dependent on ownership of traditional factors of production such as land, physical capital, and mineral inputs. Knowledge may even become the most valuable property in society. The rising influence of who knows what as opposed to who has what could, according to McHale, "lead to shifts in policy decisionmaking control functions in various institutional sectors, which now come to be associated with the new wealth and power inherent in information/communications technologies." [8]

Just as agriculture has played a dynamic role in the industrial era, so will industrial production in a service-information economy. Although agriculture and industrial production remain important, however, their influence in shaping the values and way of life of the society will decline.

McHale projects that the service-information economy will result in "restructuring the society" because it will bring profound changes not only to the work place but also into the home. Thus, the two places where people spend most of their lives may be profoundly altered. As we have seen, the working environment has already been changed for most people with the rise to dominance of white-collar work, but it is likely to change much more in the future. The intrusion of modern communications technology into the home is proceeding, although less rapidly than many technologists had expected. Home communication centers (complete with two-way television hookups, plasma screens, light pens, minicomputers and other electronic equipment) which were to become commonplace over the next decade, may not arrive on schedule. Porat believes that this delay has certain advantages:

> Our society has been given a reprieve to reflect on the coming of a revolutionary new technology. We are now at the edge of an information economy. . . . But when the home is transformed by the communication center and the information utility, the information society will have arrived. The schedule has been postponed. We have one generation to attack the literacy problem, the information gap problem, the privacy problem, the lifelong learning problem. We have one generation to plan for new lifestyles, new settlement patterns, new ways of working.[9]

People's Changing Values and Priorities

It is recognized in the literature on comparative economic development that basic cultural attitudes and values are central to explaining why one economy enjoys a broadly based, largely spontaneous development while another does not. Indeed, a primary force behind the remarkable expansion of commerce and advance in technology in Europe and America since the eighteenth century was a cultural development that provided a fertile environment for the institutions of capitalism and the industrial revolution. This shift in values and priorities—referred to by Max Weber as the Protestant ethic—was a necessary

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[7] Bell, op. cit., p. 24.
[8] McHale, op. cit., p. 25.
[9] Porat, op. cit., p. 240.

precursor of subsequent events, notwithstanding the existence in Europe of rich natural resources, a favorable climate, and other conducive circumstances. Far more than a religious doctrine only, it encompassed new views on the purpose of work, the virtues of material progress, and the relationship of man to his natural environment, which were fundamentally different from the previous era.

In recent years these now traditional values have been increasingly challenged and in some cases rejected, especially among the young. The lessons of history show us the importance of the questions, whether we are witnessing a fundamental shift in beliefs and priorities which will erode the growth ethic, or whether the changes we see are only superficial and transitory.

Herman Kahn, in a monograph published by the Committee, wrote that *changing values and priorities will be among the most important influences reducing economic growth in the long term.* While strong forces favoring growth—such as rapid labor force expansion and a political reaction against recent constraints—seem sure to prevail over antigrowth factors in the near future, he foresees that new priorities will gain ascendency and tend to dampen the pace of growth substantially after 1985. Kahn writes:

> My belief that the long-term rate of economic growth will drop off in the United States and worldwide is not based on fears of pollution or lack of energy or other resources . . . long before these physical constraints set serious limits on either population or economic growth, social and cultural factors will intervene.[10]

Kahn specified a number of "new emphases and trends" that he expects to become more prevalent in competition with other values and goals in the future. Among these are risk aversion, localism, leisure, health, environmental protection, and anti-technological, anti-industrial attitudes. He also foresees a loss of public optimism, consensus, and decisiveness. Kahn expects the process by which these new values and goals become widespread, largely replacing the goal of economic growth, to have "gone quite far by the year 2000." This is the basis for his statement that "growth in both the population and the economy will very likely flatten out at some point in the early twenty-first century for the United States." [11] Kahn continues:

> Perhaps the most important and basic of these social and cultural factors making for a slowdown in economic growth is simply satiation—or at least a satisfaction of the most urgent needs and a corresponding change in priorities. . . .[12]

In testimony before the Committee, Kahn was more specific:

> When the median income in the U.S. reaches about $20,000 per capita, there will be a very big change in the system. Since more than half of the people will be satisfied, economic growth will drop very rapidly from that point on. . . .

Prof. John McHale concurred, stating, "As living standards rise and more people achieve sufficiency levels of affluence, we could approach satiation or stabilization of demand in many areas." [13]

Perhaps one of the most succinct statements on the relationship between affluence, value changes, and economic growth was made by

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[10] Kahn, pp. 21–22.
[11] Kahn, p. 19.
[12] Kahn, p. 22.
[13] McHale, p. 48.

Gardiner Ackley, former Chairman of the President's Council of Economic Advisers:

> It remains my own sober guess that, at least for us in the already developed world, the ultimate limits to growth will basically reflect not resource scarcities but a steadily rising human preference for essentially noneconomic endeavors and satisfactions. In other words, I doubt that externally imposed limits to growth will require a new ethic and life style: rather, I suspect, an ever-increasing abundance will generate an ethic or life style which will cause economic growth to slow and ultimately to cease. And as that happens, we may not even recognize it because the question of growth will have become so uninteresting.[14]

In other words, people who have attained an affluent standard of living—and particularly those who never have known any other standard—tend to experience a decline in economic drive and to place increased value on comfort, leisure, and safety. This phenomenon may help to explain why many middle-class teenagers and young adults, raised in the affluent postwar period, have developed attitudes different from those of their parents. Willis Harman of the Stanford Research Institute has described the nature of this shift in priorities as:

> Rejecting material achievements, status goals, and conspicuous consumption as central activities giving meaning to life and espousing meaning centered on authentic behavior and self-development and expressions; rejecting a work-dominated life with strict separation between work and play and espousing a concern with wholeness and integration of work, growth and play.[15]

Herman Daly, writing in his paper for the Committee on the transition to a steady-state economy, argues quite explicitly that growth will no longer be desirable. He maintains that it may be argued from "moral and ethical first principles" that economic growth beyond some point does not serve man's highest ends but in fact renders a disservice. He speaks of an "Ultimate End" whose pursuit in the areas of ethics or religion is hindered by a society's emphasis on economic growth. More concretely, Daly contends that, when society has reached a level of affluence such that *relative* wants (i.e., status relative to one's peers) become the dominant concern at the margin, then aggregate growth becomes either futile or the source of increasing inequity. To the extent that it is higher relative income that is important, he believes, growth becomes unimportant.

No one observing the youth culture of the past ten years can doubt that a substantial change has occurred, but one may question the durability of new attitudes among the young. On one hand, the intense competition for jobs among today's young people (see Chapter III) may encourage them to adopt more caution and conservatism as they undertake family responsibility and strive to develop careers. On the other hand, the difficult job market that will continue to confront this first postwar generation may cause some to chafe under the disappointments of working life and to adopt less productive work patterns. Whatever the case, most people retain some loyalty to their youthful ideals in their later lives, and the evolution in values that has occurred undoubtedly will be reflected to some degree in the subsequent behavior of today's young people.

Another kind of stimulus producing changes in values is the growing recognition of the fact that scientific and technological advance is

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[14] Gardiner Ackley, "Prospects For The U.S. Economy," p. 432.
[15] Willis Harman, "Contemporary Social Forces," The Futurist, February 1977, p. 68.

a double-edged sword that threatens man and his environment while at the same time offering the tempting possibility of a better future. As knowledge of the delicate interwebbing of the ecological system has spread, people have demanded wide-ranging measures to protect the natural environment. As the carcinogenic nature of some industrial products and processes has been recognized, the demand for other protective measures has risen. Current apprehension about the ultimate consequences of nuclear power technology may retard a development which until recently was expected to yield a cornucopia of benefits. The threats posed by research into genetic manipulations also has aroused new reservations about the independence of science.

All of these shifts in attitudes would appear to constrain the growth of per capita income (i.e., living standards) as traditionally defined. In cases in which the antigrowth militance of interest groups thwarts developments that could provide benefits to the Nation larger than their undesirable local effects, national living standards by any measure are reduced. In other cases, however, the change in priorities means a substitution of valuable nonmarket preferences (e.g., leisure, environmental protection or job safety) for private goods with a probable gain in national welfare.

The changes in attitudes discussed in this section have recently been subsumed in the phrase "social limits to growth." Their importance has been acknowledged even by Jay Forrester, an originator of the thesis concerning physical limits to growth. In his submission to the Committee, Forrester stated that social limits—which he said involve resistance to rising population density, growing industrialization, capital-intensive production, and advancing technology—are exerting increasingly powerful influences in the United States.

Other growth experts are just as assertive concerning the primary role of social limits to growth. King Hubbert, a leading geophysicist, recently stated:

> Our principal impediments at present are neither lack of energy or material resources nor of essential physical and biological knowledge. Our principal constraints are cultural.[16]

Lincoln Gordon wrote in 1976 that:

> Both rates and directions of growth, outside the most crowded world regions exposed to the Malthusian trap, will be more influenced by changes in values and attitudes toward both consumption and production than by physical constraints. That conclusion is strongly reinforced by the preliminary findings of an RFF (Resources for the Future) study on relations among population, resources, and environment in the United States up to the year 2025.[17]

The belief that social limits to growth will be the most prevalent limits also in other countries was supported in the recent United Nation's study directed by Wassily Leontief. It concluded:

> The principal limits to sustained economic growth and accelerated development are political, social, and institutional in character, rather than physical.[18]

A fundamental conclusion to be derived from both the Committee-sponsored studies and other recent investigations, therefore, is that social, rather than physical, limits will be the more important type of

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[16] Quoted from Gladwin Hill, "Scientist is Hopeful on World Resources," New York Times, December 2, 1976.
[17] Lincoln Gordon, "Limits to the Growth Debate," p. 6.
[18] Wassily Leontief, "The Future of the World Economy," p. 48.

constraint on economic growth over the next quarter century. It is clear that the values, attitudes, and priorities of Americans have changed significantly in the recent past, and it is likely they will continue to do so during the next decade.

If this perspective is correct, the following advice from Gordon is highly pertinent:

> It would be well for us to close the book on the growth-limits debate and to start exploring the more difficult but more relevant terrain of social adaption to changing consumption preferences and changing attitudes toward employment and job satisfactions.[19]

As Hubbert put it:

> It behooves us while there is yet time to begin a serious examination of our cultural constraints and of the cultural adjustments necessary. Provided this can be done before unmanageable crises arise, we could be on the threshold of one of the greatest intellectual and cultural advances in human history.[20]

Increasing Social and Technical Complexity

Another feature of growing importance in our economy's evolution is the sheer complexity of institutions and technology. This phenomenon is related, of course, to the development of information and knowledge discussed earlier in this chapter. As stated in a recent report of the World Future Society (WFS) "such complexity is the inevitable result of the exponential growth of applied science and technology." [21]

The increasing importance of knowledge has resulted in greater specialization, which has increased efficiency at the cost of tremendously increased interdependence among organizations, production processes, and distribution networks. Modern industry also has tended toward extremely large scale, which achieves tremendous economies but increases risk and barriers to entry.

Density of development and technical complexity have increased the cost of management and coordination, both for enterprises and for government. The interrelationships among regions and fields of knowledge have made interagency task forces, regional commissions, interdisciplinary research, and other more complex means of addressing problems into watchwords of recent years, as previously unrecognized considerations have crowded in upon decision makers. Industry now operates under numerous new constraints aimed at environmental protection, worker safety, and sales practices. Site approvals become more difficult and time-consuming. Business complains of suffocating red tape. At the same time, enterprises themselves are becoming larger and more unwieldly.

Rapid growth depends on successful management, but management becomes mired down in complexity. It often appears that the time available between the perception of problems and their becoming critical has tended to shorten as the time required to deal with them has lengthened.

The WFS report notes that the increase in specialization, interdependence, and the scale of enterprises has given rise to another char-

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[19] Gordon, op. cit., p. 6.
[20] Hill, op. cit., (#16).
[21] World Future Society, "An Introduction To The Study of The Future," p. 4.

acteristic of modern society—system vulnerability. Many of today's systems are extremely vulnerable to failure of a subcomponent. The most dramatic illustrations of this problem are blackouts in the Northeast in 1965 and in New York City in 1977.

Jay Forrester in his testimony before the Committee maintained that the trend toward economic density and dangerous side effects from technology will require an increase in government authority and control that will be inconsistent with our ideals of a free economy and society. It is for these reasons, among others, that social philosphers such as E. F. Schumacher urge a decentralization of populus and simplification of production processes. A limited decentralization of people already is discernible from census data. However, the cost and payoff of moves to reverse the complexity of today's economy in various regions and sectors has yet to be determined.

Increasing Rigidity of Interest-Group Demands

Mancur Olson, in his monograph and testimony before the Committee, emphasizes the secular increase in the number and power of special-interest organizations as a cause of declining growth rates in mature economies. These organizations include labor unions, professional associations, farmers' organizations, trade associations, and other lobbying groups. The longer a country enjoys peaceful development together with freedom of organization, Olson suggests, the greater the extent to which organized interests weave webs of constraints that slow its growth. Barriers erected to protect special interests curtail the growth of productivity and thus in income by preventing the flow of resources to their best uses. For example, these groups often have an incentive to block or delay innovations as well as to keep new entrants out of their industry or occupation. Members of a common-interest organization often can gain substantially from a policy that reduces the output of the society as a whole, because they get most or all of the gains of the policy and bear little or none of the costs.

Olson lends some empirical plausibility to his thesis by pointing out that the highest growth rates in the postwar period have been enjoyed by those countries—Germany, Japan, and Italy—where institutions were most extensively destroyed by the war; and that the slowest growth has occurred in those countries—the United Kingdom and the United States—that have had the longest periods of uninterrupted industrial development.

Allvine and Tarpley, in their paper, lend support to the Olson thesis. They stress that one of the difficult problems confronting our economy is that strong vested interests have developed throughout society, each endeavoring to protect its gains from the pressures of a competitive marketplace. Other witnesses, asked to evaluate the Olson thesis, found it to be generally plausible as *one factor* explaining economic performance. Harman called it "an interesting partial explanation for a complex phenomenon," Gary Fromm of the National Bureau of Economic Research agreed that this probably is one factor in Britain's decline but did not expect it to have a similar effect in the United States. He stated that Olson placed too much emphasis on this factor. Clopper Almon of the University of Maryland stated that

Olson's hypothesis may have a great deal to do with the recent productivity slowdown, and Wassily Leontief said, "Olson's argument, I think, is correct."

The American economy, it is true, is rife with special-interest protection: certain types of work rules; building code restrictions; protection from competition for regulated firms in the transportation, financial, and telecommunications industries; import restrictions on textiles, shoes, television sets, and specialty steels; and tacit or official pricing arrangements in many other industries. The difficulty of breaking down these restrictions, despite their high costs to the public, is well known.

The postwar period nonetheless, has witnessed a very extensive dismantling of trade barriers around the world; government-imposed restraints on price competition in the marketing of securities have been relaxed recently; State "fair trade" laws, which permitted manufacturers to prescribe minimum retail prices, were invalidated in 1976; lawyers' fee schedules were outlawed recently by the courts; Federal transportation regulators have moved to ease their restrictions; and a strong campaign currently is being waged in Congress to reform the guidelines for regulation of the airlines. Most of these efforts to break down restrictions are recent, and their effectiveness and the chances for more far-reaching reforms are not clear. But a substantial campaign to reduce such barriers is under way and has scored some success.

Long-Wave Theories

Professors Nathaniel J. Mass and Jay W. Forrester of the Massachusetts Institute of Technology have suggested that economic developments are influenced by several cyclical patterns superimposed on each other. In addition to the familiar four to six-year business cycle, which is explained partly by the cycle of inventory accumulation and reduction, they believe that the economy may be subject to a "long wave" (or Kondratieff cycle) of 45 to 60 years. They also refer to a "life cycle of economic development," which may run perhaps 200 years or more. "For the first time in the Nation's history," they say, "we may face the triple coincidence of a business downturn, a long-wave collapse, and the pressures of the transition region," by which they mean a secular change from a fast growing economy toward a stable or perhaps declining one.

The long-wave theory was based initially on the work of the Russian economist, Kondratieff, who pointed out that economic variables including prices, wages, and interest rates seemed to reach low points around 1790, 1845, and 1895 with intervening peaks around 1815, 1870, and 1920. Mass and Forrester point out that this kind of pattern could be extended with a trough in the 1930s. They suggest that the subsequent peak may be upon us or indeed already past.

These authors attempt to explain the long wave as a result of a long cycle of investment in fixed capital similar to the shorter cycle in inventory investment. They say, for instance:

> . . . consider the U.S. economy at the end of World War II. After the Depression and the War, the capital plant of the country was depleted . . . Automobiles were worn out, housing was inadequate, commercial buildings were old, and production equipment was obsolete. The physical capital stock of the country was at low ebb. But to refill the depleted pool of physical capital in a rea-

sonable time, like twenty years, required a production rate greater than would be necessary to sustain the capital stock once the pool was filled. . . . The capital sectors would consequently overexpand and then be forced to retrench.[22]

They suggest that each long period of relative prosperity causes excesses stemming from reduced concern about risk and instability, a consequent relaxation of lending standards, and recklessness on the part of investors. They attempt to draw parallels between recent indicators of economic imbalance and those that preceded the Great Depression, pointing out especially the persistent rise in the role of debt finance since the 1950s.

Evidence of an emerging excess of capital is seen in the decline of capacity utilization rates, high unemployment (even for college educated persons), growing debt burdens on corporations, faltering growth in capital replacement, and other symptoms. All of these observations, if valid, would lead one to expect a capital surplus in the future rather than a capital shortage, which many people have predicted.

The reference to the role of depression and war in setting the stage for the boom of the 1950s and 1960s brings to mind the timing of wars in the earlier cycles mentioned by Kondratieff. The depression around 1790 was accompanied in Europe by the French revolution and followed by the Napoleonic wars; the end of the Napoleonic wars ushered in an era of economic progress and growth. After a long period of peace, the economic malaise of the 1840s was followed by the political turmoil of 1848 and, later, by the European and American wars of the 1860s; the economic expansion of the 1870s and 1880s ensued. The economic lows around 1895, referred to by Kondratieff, preceded World War I by nearly 20 years, but, again, the boom of the 1920s followed the war.

Thus, major wars occurred between each of Kondratieff's lows and his subsequent high points. We cannot attempt here to evaluate authoritatively the cause-effect relationships behind these cycles. One is tempted, however, to wonder whether the declining phase of the investment cycle and the depressed business conditions accompanying it led to social unrest and helped to set the stage for war, or whether on the other hand unrest and threats of war, arising independently of economic conditions, suppressed investment and business conditions. Similarly, one may ask whether the revival of investment ensued from a purely economic cycle or whether it took the form of a response to investment opportunities backlogged during times of political uncertainty and released, in a wave, by the return of more stable political and social conditions. Possibly the investment cycles alluded to by Mass and Forrester may explain even more than these authors have suggested. On the other hand, these cycles of depression, war, and boom may require a much more complex explanation. It also is possible that the repetition of these similar occurrences is coincidental.

Mass and Forrester show that, when a long-wave pattern of economic activity is superimposed on a series of short-run business cycles, the result during the long wave's upward phase is to lengthen the boom period of the short-run cycle and to shorten the recessions. The reverse occurs during the long wave's downward phase. They speculate that a

[22] Mass and Forrester, p. 54.

rising long wave may explain part of the postwar prosperity and suggest that anticyclical economic policy perhaps should receive less of the credit for the advances of this era than it has been given. The current lag in business investment compared to its earlier postwar pattern may reflect a peaking of the long wave in investment activity.

Mass and Forrester state that there is no reason to believe that conventional anticyclical monetary policy will be effective in combatting a downturn of the Kondratieff cycle. It should be pointed out, however, that a protracted decline in private investment could be offset systematically through a higher rate of public investment with an equivalent stimulus to the economy. It has been said that the United States is privately rich but publicly poor; that is, poor in terms of public facilities and services. Thus, a policy of public investment to counteract a long period of underinvestment in the private sector could help to rectify this deficiency and, at the same time, could boost activity in all spheres of the economy.

Mass and Forrester also are concerned about the possibility that civilizations experience a "life cycle" of economic development, i.e., rapid expansion over a period of 200 years or more followed by gradual transitions to "maturity" and slower growth or even decline. (This pattern is represented by an S-shaped "logistics curve.") They attribute the slowdown basically to shortages of resources and problems in disposing of pollution. At some point, congestion, resource depletion, technical complexity, and pollution begin to generate social frictions and counterpressures to growth. There are signs, they say, that the American socioeconomic system is in a transition stage to slower economic growth. They see these signs in the retarded growth, higher unemployment, and inflationary pressures stemming from the raw materials sectors that have manifested themselves in the past several years.

In appraisal of this thesis, it must be said that the evidence advanced by the authors is sketchy and the analysis superficial. All civilizations that have flourished economically have gone into long periods of stagnation or decline within a few hundred years. Thus, one cannot rule out the operation of some such mechanisms at some time in the future. On the other hand, few civilizations have begun with half a virgin continent to exploit, as did the United States. The symptoms discerned in the United States can be attributed to other causes. Many nations today are far more densely populated than this country but sustain similar living standards and continue to grow. Thus, the reason for this "life cycle" would seem to lie more in the social development of civilizations than in shortages of resources and capacity to dispose of pollution.

In any case, Mass and Forrester conclude:

> Failure to recognize these long-term forces could lead to government actions that are ineffective or which make matters worse. The result would be an intensified sense of public futility. . . .[23]

If these forces exist, this conclusion will be valid. Their proposals for adapting policy to take account of them, however, remain preliminary and tentative. Their efforts to refine this research are continuing.

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[23] Ibid., p. 70.

III. HUMAN RESOURCES

The development of the Nation's human resources—quantitative and qualitative—has been the dominant contributor to its economic growth, according to studies by Edward Denison and others. One can now foresee, however, that future manpower development will be much different from the past in both of these respects.

The advent of slower population growth since about 1960 will curb the contribution of labor to the economy. It should permit the achievement of generally lower unemployment rates, however, and could create a persistent tendency toward labor scarcity by 1985, especially for entry-level and low-status jobs, unless immigration policies either are modified or remain ineffective in preventing labor inflows. As we shall see, however, the tight job market may not extend to highly educated manpower.

Slower population growth and the rising average age that will accompany it also will affect the composition of demand within the Nation's economy. For instance, it will accelerate the long-term shift toward a service economy and result in slower growth for basic materials industries, among others. If the transition implied by slower population and labor force is planned and managed skillfully, then it could result in an *accelerated increase in per capita incomes*, i.e., living standards. If the transition is permitted to run its course without adequate foresight and policy response, it could be accompanied by nagging problems of structural unemployment and technological stagnation in certain basic industries.

Some observers believe that increases in education will be less significant as a factor in economic growth than in the past. A sizeable percentage of the recent recipients of higher education are now unable to obtain jobs making reasonable use of their training. Due to the large fraction of the record number of young people attending college since the mid-1960's, underemployment of college-taught skills may remain a long-term problem unless programs are developed to mitigate it. In this case, the returns to college education would decline, and college attendance would decline correspondingly. The potential for social discontent implicit in this kind of underemployment and in the implied limitation on education as a route to economic advancement could be serious.

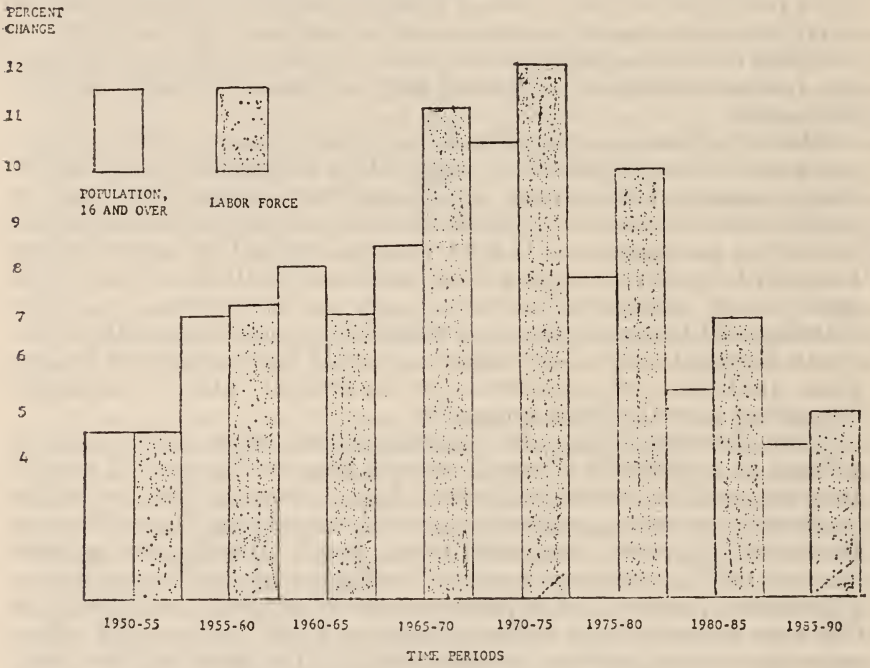
Reduced Population and Labor Force Growth

Changes in labor force growth and composition for a period extending 15 to 20 years into the future are more readily foreseeable than other socioeconomic variables, because they derive from established facts such as recent birth rates and from relatively stable phenomena such as schooling and training patterns, labor force participation rates, and labor force attrition. Recent analyses by the U.S. Bureau of Labor Statistics (BLS) of population and labor force trends and projections

and their effects on economic development prospects have been subsumed for the Committee in a paper by Charles Bowman.

Bowman shows that dramatic changes in the factors contributing to labor force developments have occurred, especially in the past decade. As shown in Figure III–1, the work-age population and the labor force grew by expanding leaps and bounds through 1975. The postwar baby boom generation was coming of age. Meanwhile, however, birth rates and population growth had declined since about 1960. These declines, which may well continue in the future, have far-reaching implications for the future growth and the age-sex makeup of the U.S. labor force as well as for the growth and composition of output which are beginning to unfold.

FIGURE III–1.—Percent changes in civilian noninstitutional population and labor force, 1950–90.



Source: Bureau of Labor Statistics.

The average annual growth rate of the civilian labor force is projected to drop from 2.3 percent for the period 1970 to 1975, to 1.9 percent for the years 1975 to 1980, and 1.2 percent in the first half of the 1980s. By the second half of the 1980s, the labor force is projected to grow at only 0.9 percent per year, or two-fifths as fast as during the recent past.

Sharply slower labor force growth will have radical effects on the age composition of job holders. The share of teenagers and young adults will drop precipitously. Workers 16 to 24 years old will decline from 24 percent of the labor force in 1975 to 18.5 percent in 1990.

The baby boom generation will approach middle age; the fraction of all employed persons in the 25-to-54 age group will rise from 60.6 percent—the postwar low point—to 69 percent. In sum, the rapid growth of the labor force in the ten years through 1975 was due to a rapid expansion in the number of young workers, while in the future these will become older, more experienced workers, and the youthful contingent will fall.

The BLS concludes that this shifting age distribution of the labor force will make attainment of low unemployment rates successively easier from now through 1990, assuming that other factors do not change adversely. The evolution also has certain other effects. Harold Wool, for instance, in a study for the Department of Labor,[1] found that we can expect substantial reductions in the proportion of workers available for the lower level occupations, which are filled to a sizeable extent with young people. This could be expected to affect the wage levels, working conditions, fringe benefits and job security of people performing such jobs.

Labor force participation rates in the past generation also have changed markedly for both men and women, although in opposite directions. Participation among men has declined for each age group during nearly every period since 1950. This is particularly true for older men. Participation among those 65 and older fell from 46 percent in 1950 to 22 percent in 1975. For men of age 55 to 64, the rate dropped from 87 to 76 percent with most of the drop occurring since 1970. The average participation rate for men would have been still lower since 1965 but for the rising propensity to work of youths 16 to 19 years of age.

The dramatic increase in participation rates among women, particularly since 1965, has offset the declining rate for men. Their rates have risen steadily from 34 percent in 1950 to 46 percent in 1975. The female population increased from 1947 to 1975 by 52 percent, while the female labor force increased by no less than 123 percent. Of the 1.5 million persons added to the labor force in 1975, 1.1 million were adult women.[2] The combined effect of declining male and rising female participation rates has raised the fraction of the labor force composed of women from 30 to 40 percent during the past quarter century—a percentage point increase almost as large as that of the preceding 60 years.[3] Women, however, have entered the less skilled occupations in disproportionate numbers, which has limited their contribution to productivity growth.

The BLS projects that men's propensity to work will stabilize in the future at about the 1975 level. Women's participation rates, however, are projected to rise from 46 percent in that year to 50 percent in 1985 and to over 51 percent in 1990. This further rise is premised on the continuation of relatively low birth rates, freeing more women to work. Thus, a rising labor force participation rate for women, by raising the overall participation rate by over 2 percentage points (to 63.6 percent in 1990) is projected to mitigate the effects of slowing growth in workage population to a limited extent. These effects are encompassed in the labor force growth rates forecast above.

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[1] Harold Wool, "Future Labor Supply for Lower Level Occupations," p. 27.
[2] John O'Riley, "The Outlook," The Wall Street Journal, March 1976, p. 1.
[3] Andrew M. Sum, "Female Labor Force Participation: Why Projections Have Been Too Low," p. 18.

Effects on Economic Growth and Living Standards

What will be the effects of slower population growth on the growth of the economy and the living standards it provides? This question has been addressed by the Bureau of Labor Statistics and also in papers for the Committee by Singer and Perry of the University of Virginia and by Cetron and Sugarek of Forecasting International, Ltd. The answers provided by these three sources yield a large measure of agreement that growth of the aggregate economy can and must continue, although at a somewhat slower rate, and that per capita welfare can rise faster if population growth remains low.

The BLS projects that there will be no decline in GNP growth between the periods 1973 to 1980 (3.7 percent annually), and 1980 to 1985 (3.6 percent), despite a drop of 0.6 percent per year in the labor force growth rate (from 1.8 to 1.2 percent). This decline in labor growth is projected to be offset in two ways: (1) through a small decline in unemployment from 1980 to 1985 and (2) through an increase in the rate of productivity gain.

One of the primary reasons for optimism concerning both of these important variables is that the prime age labor force—composed of persons aged 25 to 54—should grow much more rapidly over the next 15 years than either the older or the younger group of workers. BLS projects annual expansion rates for this prime age group of 2.1 percent during the late 1970s, 2.4 percent in the early 1980s and 2.1 percent thereafter. This would increase their proportion in the labor force from 61 percent in 1975 to 65 percent in 1985 and to 69 percent in 1990.

The BLS projects unemployment to decline to 4.7 percent in 1980. This is more ambitious, however, than the Carter Administration's target of 4.75 percent in 1981 and may not be achieved. The BLS then projects a 4.0 percent rate by 1985. The rate of unemployment attainable without excessive inflation will decline as the rate of labor force growth and the proportion of youthful workers fall.

Regarding productivity, the BLS projects that its growth over the 1973–1980 period will be slightly faster (2.2 percent) than from 1968 to 1973 (2.0 percent). It then assumes that productivity will return in the 1980s to the higher, 2.6 percent rate that characterized the era from 1955 to 1968, which has been used to represent the postwar trend. While it is plausible that the recognition of chronic labor

scarcity will stimulate productivity through labor-saving investments, as it did in that earlier period, many observers also expect productivity gains in the conventional sense to be retarded to some extent by the decline since the mid-1960's in research and development effort and the need for "defensive" investments in the fields of energy substitution, pollution control, and worker health and safety.

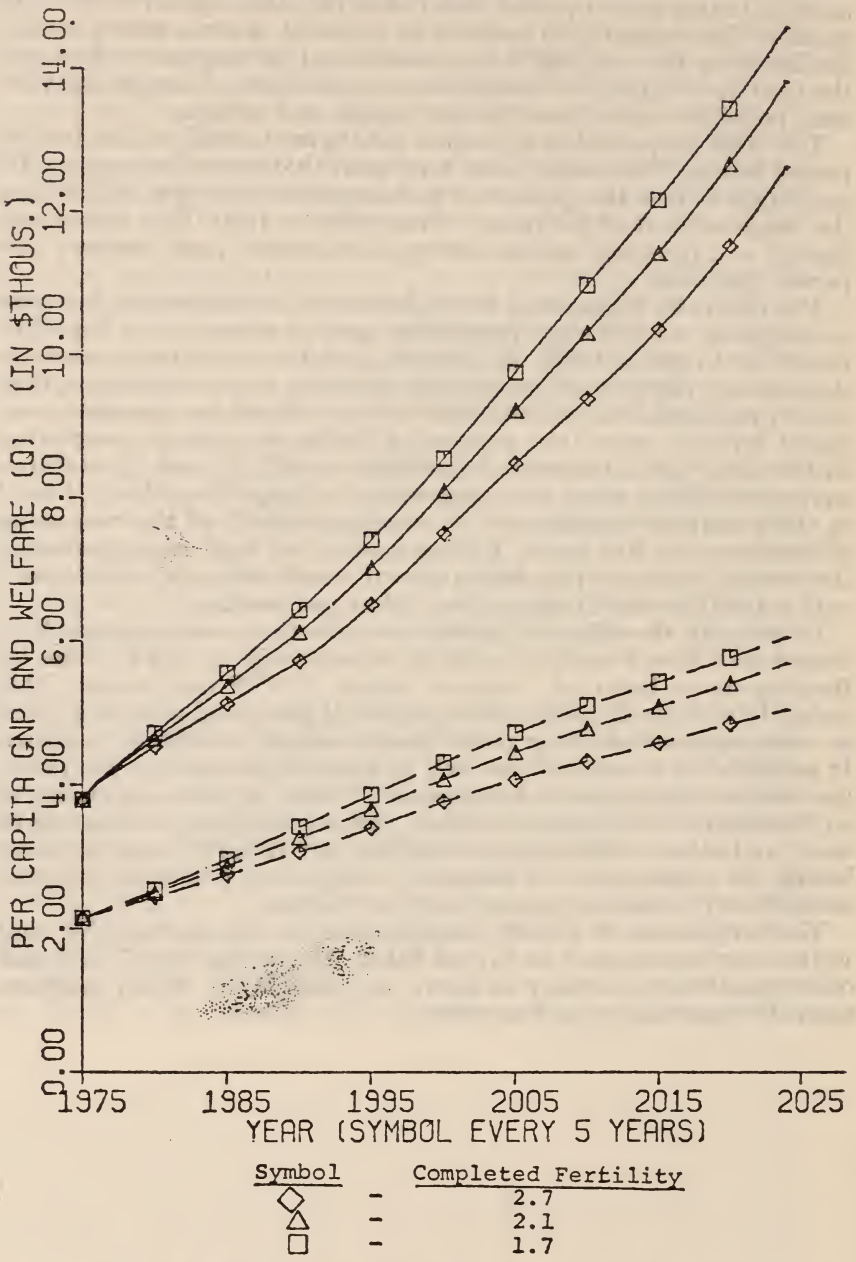
The BLS projects that aggregate GNP growth will decline for the period beyond 1985, when labor force growth drops off even more. Its projection is that the growth of full-employment output will fall to the neighborhood of 3.0 percent from 1985 to 1990. This still would signify a 2.1-percent annual increase in output (and income) per person employed.

The report by Singer and Perry draws on the results of a five-year investigation of different population growth scenarios at the University of Virginia. Using an intricate model to simulate the relationships among population, production, resources, and environment, they made projections for the next half century based on alternate completed fertility rates (the number of births per woman completing childbearing age). Completed fertilities of 2.7, 2.1 and 1.7 children were tested. Birth rates were assumed to converge from the 1974 level to the postulated equilibrium by closing one-half of the remaining difference every five years. Taking account of legal immigration at the present level, zero population growth would ultimately be attained with a fertility rate of about 1.9 children per woman.

In gauging the effect of population growth in economic welfare, Singer and Perry went beyond its relationship to GNP alone by focusing on an index of a selected subset of GNP components. This index, labeled the Q-index, encompasses all goods and services related to consumption, including public goods such as recreation facilities. It excludes all investment, as well as government outlays for pollution control and resource development. It also excludes expenditures on "necessary evils" such as defense, police protection, commuting to work, and others which do not contribute to "welfare" except by combating the consequences of inequality, congestion, and other negative side effects of economic growth and civilization.

The projections of fertility implications for per capita GNP and welfare are summarized in Figure III–2. The sensitivity of these and other variables to fertility is shown in Table III–1, which indicates their divergences by the year 2020.

FIGURE III-2.—Per capita gross national product (solid lines) and per capita welfare (dashed lines).



Source: Singer & Perry, "The Economic Effects of Demographic Changes," in "U.S. Economic Growth from 1976 to 1986: Prospects, Problems, and Patterns," vol. 11, "Human Capital," studies prepared for the use of Joint Economic Committee, Congress of the United States, May 24, 1977.

TABLE III–1.—RESULTS OF THE SINGER-PERRY MODEL FOR THE YEAR 2020

Variable	Completed fertility[1]		
	2.7	2.1	1.7
Population (millions)	380	297	251
Labor Force (millions)	184	158	141
Capital stock (trillion 1958 dollars)	9.0	8.2	7.8
GNP (trillion 1958 dollars)	4.4	3.8	3.4
GNP per capita (thousand 1958 dollars)	11.5	12.7	13.5
Q-index (100 in 1975)	227	253	269

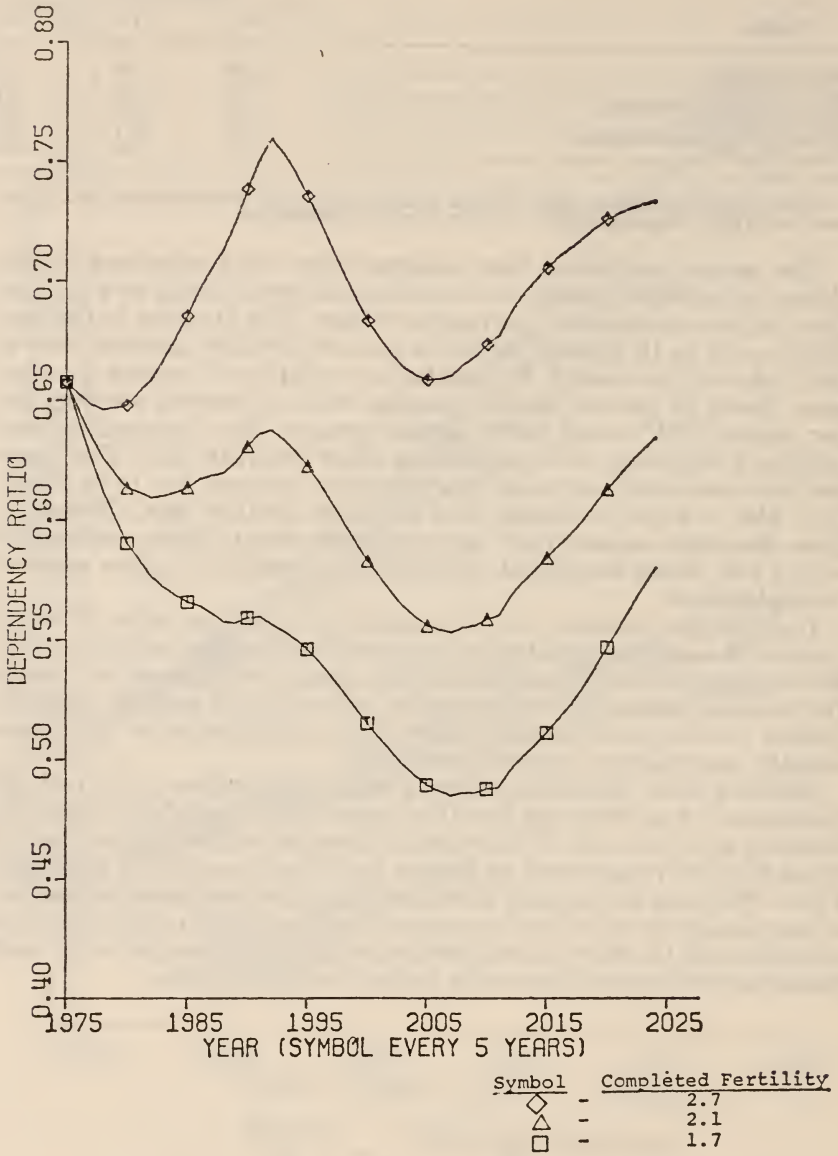
[1] Completed fertility is the average number of children per woman on completion of the child-bearing years. The age-specific fertility of 1974 was projected with a 5-yr halftime to assumed equilibrium rate.

The major conclusion that emerges from the projections is that slower population growth, or even eventual zero growth or a population decline can enhance per capita welfare. The Q-index in the year 2020 would be 19 percent higher in the low-fertility scenario than in the high-fertility case. U.S. population would be 34 percent smaller; labor force, 23 percent smaller; capital stock 13 percent smaller; but per capita GNP would be 17 percent greater. The low-fertility case implies a declining total population after the year 2020. The intermediate case, implying moderate population growth due to immigration, also is more favorable than the high-fertility case. Obviously, these forecasts assume that slower growth due to labor constraints would not create structural problems that result in higher rates of unemployment.

In short, the economy will be smaller in aggregate after 20 or 25 years with a smaller population, but individual welfare will be greater. Even aggregate GNP would be slightly greater with lower birth rates for the next generation or so, because reduced child-rearing responsibilities would permit female labor force participation to rise more rapidly, resulting in a larger labor force.

Reduced birth rates bring about a marked reduction in the ratio of population of nonworking age (the dependent population) to that of working age (18 to 65). The course of these dependency ratios for the three fertility rates tested by Singer and Perry are shown in Figure III–3. The peak in the early 1990s results as the baby boom generation is completing its child-bearing years. The rise in 2020 results from the retirement of the baby boom contingent. Both of these peaks are well below the 1975 dependency ratio in the low-fertility case.

FIGURE III–3.—Dependency ratios (nonworking age population to that of working age (18–65 years).



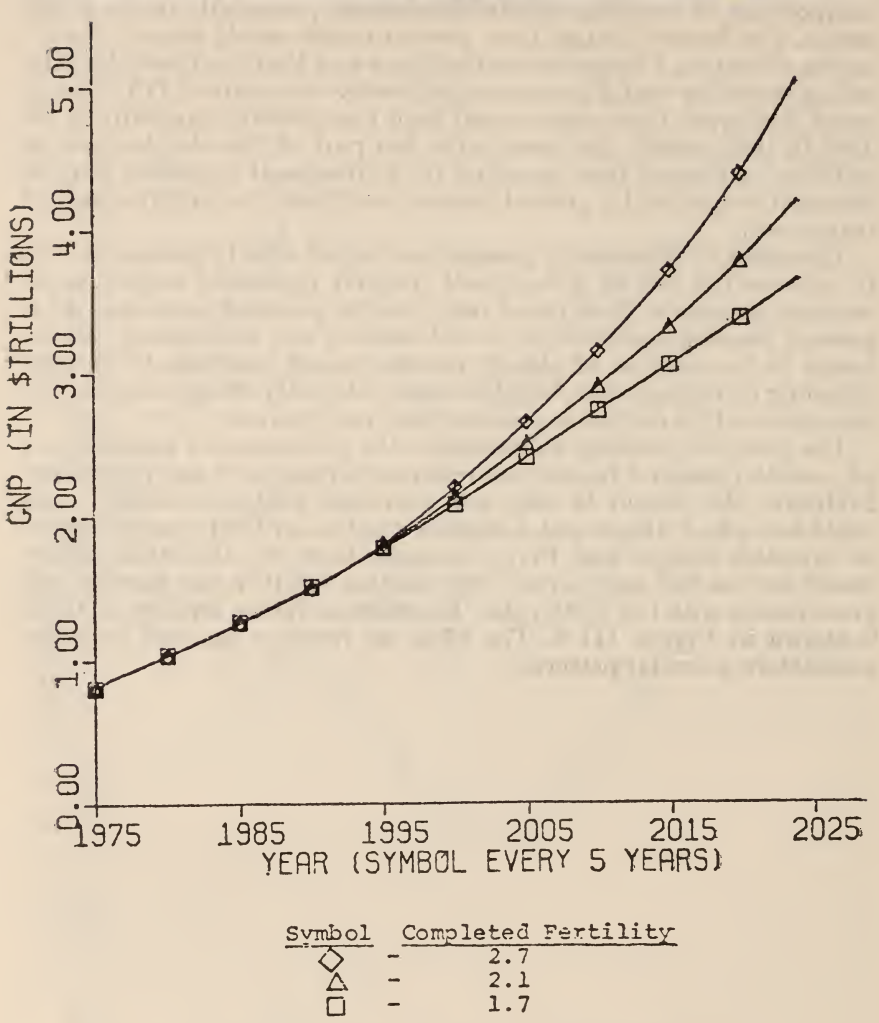
Source: Singer & Perry, "The Economic Effects of Demographic Changes," in "U.S. Economic Growth Patterns," vol. 11. "Human Capital," studies prepared for the use of the Joint Economic Committee, Congress of the United States, May 24, 1977.

Movement toward zero population growth also would affect the composition of spending within the economy, especially in the public sector. The largest change from present trends would come in spending on education. Computations by Singer and Perry indicate that education spending would increase significantly as a share of GNP in any event, but lower birth rates would limit this growth, especially in the 1985 to 1995 period. Analyses in the last part of this chapter seem to indicate, moreover, that spending on professional education may be stemmed somewhat by glutted market conditions for highly educated manpower.

The effect of a relatively greater number of elderly persons will be to increase the role of government transfer payments, largely social security payments. This trend may involve political repercussions if present funding methods for social security are maintained. An increase in the number of elderly persons would tend also to increase spending on medical care, but this seems to be fully offset in the model's calculations by a decline in medical costs for children.

The greatest spending differences in the private sector arise because of a smaller demand for natural resource development and processing. Pollution also would be less, and therefore pollution control costs could be curbed. In general, a smaller fraction of GNP would have to be invested. Singer and Perry indicate, however, that these effects would not be felt until after 1995, because GNP in the interim will grow fastest with low birth rates. The effect of future fertility on GNP is shown in Figure III–4. The effect on resource use and pollution would show a similar pattern.

Figure III–4.—Gross National Product (GNP) in 1958 dollars.



Source: Singer & Perry, "The Economic Effects of Demographic Changes," in "U.S. Economic Growth from 1976 to 1986: Prospects, Problems, and Patterns," vol. 11, "Human Capital," studies prepared for the use of Joint Economic Committee, Congress of the United States, May 24, 1977.

On the other hand, the trend toward consumption of services would be accelerated by higher per capita incomes, and there would be a marked increase in spending for housing and household furnishings, as well as for travel and other recreation activities.

Singer and Perry examined the argument that the business environment and the international competitiveness of the U.S. economy could be hurt by slower aggregate growth because profitability and its incentive for investment, risk taking, and innovation would be reduced. This issue is discussed at length in Chapter IV.

The paper by Cetron and Sugarek shows that because zero population growth would be achieved only after a number of decades, zero

economic growth in the meantime would result in nearly a 40-percent decline in per capita income before the attainment of full population stability. They calculate that GNP must continue to grow at somewhat more than 1 percent per year only to maintain constant living standards through the year 2020, even if population is converging toward long-run stability. It clearly must grow faster to maintain full employment. This analysis confirms the work of Lester Thurow, in his paper for the Committee, on the consequences of zero economic growth.

The conclusions of these studies are in accord with those of the 1972 report of the Commission on Population Growth and the American Future. The Commission judged that:

> From an economic point of view, a reduction in the rate of population growth would bring important benefits, especially if the United States develops policies to take advantage of the opportunities for social and economic improvement that slower population growth would provide.[4]

The Declining Contribution of Higher Education

Higher education is purchased partly for consumption (i.e., enjoyment) and partly as an investment to yield future income (i.e., "human capital"). In the past, especially since World War II, investment in human capital has resulted in substantial increases in productivity and national income. All increases in educational attainments were estimated by Denison to account for about 25 percent of the rise in output per worker from 1929 to 1969.[5] The rise in education accounted for almost one-third of the total contribution of labor to the growth of national income.

Underemployment of Educated Manpower

Stephen Dresch, in a paper for the Committee, argues vigorously that education will contribute less to growth in the future, because the market for highly educated manpower now is glutted, especially at the younger ages. He shows that the oversupply is more than just a manifestation of prolonged recession but may represent a much longer term problem. This situation has arisen, he says, as a result of a sequence of circumstances over the past 50 years.

The cataclysmic events of the 1930s and 1940s interrupted the commercial exploitation of new technology, the development of new industries, and the long-term evolution of the economy toward processing and service industries. Therefore, a large backlog of adjustments to technological and other developments had accumulated to be carried out when normal business conditions returned after World War II. Meanwhile, the number of persons of college age was growing slowly during the 1930s, and the average annual growth in college enrollments declined to 3 percent from 6 percent in the 1920s. World War II, of course, delayed the educations of most young men.

Then came the postwar avalanche of development and change, which continued with interruptions for about two decades. The education-intensive sectors expanded greatly during this epoch. Certain

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[4] The Commission on Population Growth and the American Future, "Population and the American Future," p. 38.

[5] Edward F. Denison, "Accounting for United States Economic Growth," p. 136.

major industries employing few college graduates, such as agriculture and coal mining, continued their precipitous employment declines. Meanwhile, each sector continued to upgrade the educational attainments of its own personnel.

In the face of this rising demand, the number of persons of college age went into a long-term decline. From 1940 to 1960, the number of persons, 18 to 24 years old, fell by an average of 0.25 percent per year. In Dresch's words:

> Just as the economy was able to incorporate the technological and organizational changes which had been held in abeyance by depression and war, the age group for which educational attainments were subject to modification began to contract significantly.[6]

The result of this manpower squeeze was a radical increase in the fraction of the college-age cohort actually enrolled in school. This fraction rose from 9 percent in 1940 to 20 percent in 1960. Nevertheless, total college enrollment grew by an average of only 1.9 percent per year during the decade of the fifties, the lowest rate for any decade of this century.

After 1960, the college-age population suddenly began to soar as a result of the postwar baby boom. From 1960 to 1970, it grew at 4.5 percent annually. The high rates of college attendance which had become customary, however, continued to rise rapidly. Therefore, the growth rate of college enrollments increased from 1.9 percent annually for the fifties to 8.5 percent for the sixties.

The college-educated portion of the total adult population rose gradually from 4.6 percent in 1940 to 7.7 percent in 1960. The combination of circumstances in the 1960s catapulted this fraction to 11 percent in 1970 and to 12 percent by 1972. According to Dresch, a further increase to 15 or 16 percent by 1980 can be expected with high probability. In his words:

> The inertia generated in the rapid expansion of the period, approximately 1950 to 1965, carried the system forward at an accelerating rate between 1965 and 1970, due to the discontinuous increase in the size of college-age cohorts. . . . The consequences of this rapid increase in the supply of highly educated labor, in the face of virtual stability and possibly even adverse changes in the sectoral composition of employment after 1970, is the recent emergence of a saturation of the highly educated labor market, . . .[7]

Volumes have been written about youth employment problems, but little attention has been paid specifically to the present plight of many highly educated young people in finding employment in their chosen occupations. Oversupply at the highly educated end of the labor market already is evidenced in a sharp decline in the incomes of young college graduates relative to those of high school graduates of the same age. From 1969 to 1974, the premium received by college graduates 25 to 34 years old dropped from 39 percent to 15 percent. The real starting pay of new male baccalaureates fell by about 20 percent, while average real earnings across the economy held roughly steady. Viewed in conjunction with the rapidly rising tuition, fees, and other expenses of college, this means that the return to investment in college education may have fallen by some 3 to 4 percentage points over these few years.

The deterioration in job prospects for college graduates—together with the end of college draft deferments—brought some decline after

[6] Dresch, p. 137.
[7] Dresch, p. 138.

1968 in the percentage of high school students going on to college.[8] Ironically, however, the very high youth unemployment of recent years produced a new increase in enrollments, which will mean a further deterioration of job-market conditions for graduates as the economy recovers.

While there is no question that the market for starting professional personnel is very crowded at present, the question remains whether these people can be satisfactorily absorbed, given a few years of healthy business conditions, as overall unemployment declines to low levels. Dresch believes not. Because such large fractions of today's college-educated labor force is in the younger age groups, Dresch projects that the heavy congestion in this echelon of the labor market will continue for many years. This "clot" in the age distribution of the highly educated will result in a very low rate of retirement from technical and managerial jobs between 1980 and 2000. Only after that time will substantial new opportunities for young people open up. The BLS projected in 1976 that about 13.1 million college graduates will enter the civilian job market during the years 1974 to 1985, but that only 12.1 million job openings requiring their training will be created.[9]

James O'Toole of the University of Southern California, who has explored the future of work extensively, is very concerned with the effect of so-called "overeducation" on job satisfaction. He stresses that "underemployment already is probably at the root of many of the most severe problems of industrial society, and it is certainly a major cause of job dissatisfaction and increasing demands for improvements in the quality of working life." [10]

O'Toole expands on some practical dimensions of the problem. Not enough jobs requiring technical training are being created. The two fastest growing sectors since 1955 have been the Government and "miscellaneous service" industries. Though Government has hired many college and postcollege graduates, a 1972 study reported that 60 to 70 percent of the new jobs being created in government agencies are in the categories of aide, attendant and assistant, clerical worker, custodian, and semi-skilled, blue-collar worker.[11] In general, the new jobs created between 1960 and 1970 in the United States, according to a study by analysts from HEW and the Commerce Department, "were disproportionately in the low-skill, low-paying category." [12]

Moreover, many of the new jobs that would appear on the surface to be more challenging (health paraprofessionals, teacher's aides, and the "new careers" for technicians requiring two-year AA or AS degrees) do not have career ladders and are limited in their scope by the prerogatives of the professionals who supervise them. O'Toole cites the alarming conclusions of a recent study by the Office of Management and Budget: [13] Half of all jobs do not even require a high school education, and the average education required for all jobs increased from 10.0 years in 1940 to only 10.5 years in 1970.

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[8] R. Martin and R. McCartney, "The Future Revised," The Wall Street Journal, April 18, 1976, p. 1.
[9] The Wall Street Journal, "Employment Seen Rising 20 Percent in Decade As Prospects Among Jobs Range Widely," p. 1.
[10] James O'Toole. "Work, Learning and the American Future," p. 36.
[11] B. Harrison, "Training for Nowhere," Washington Post, November 19, 1972.
[12] Fred Best and Barry Stein, "Education, Work and Leisure: Must They Come in That Order?", p. 4.
[13] A. Miller, "Occupations of the Labor Force According to the Dictionary of Occupational Titles."

Table III–2 compares the proportions of college graduates in the labor force with the proportion of professional and technical jobs in total civilian employment. It indicates that this market shifted from shortage to surplus between 1970 and 1975, and that the surplus of college graduates is projected to grow substantially by 1985. The proportion of professional and technical jobs is expected to remain about the same, while the number of college graduates continues to soar. Estimates of the over supply range as high as 6 to 8 million people.[14]

TABLE III–2.—THE NUMBER OF COLLEGE GRADUATES VERSUS THE NUMBER OF PROFESSIONAL AND TECHNICAL JOBS, 1960–85

	College graduates (percent of labor force)	Professional and technical workers (percent of civilian employment)
1960	10.0	11.0
1965	11.7	13.0
1970	13.2	14.2
1975	16.9	15.0
1985	20–21.0	14.9–15.4

Source: Fred Best and Barry Stern, "Education, Work and Leisure: Must They Come in That Order?", p. 6.

Despite disappointing job prospects, college graduates are not expected to become unemployed in large numbers. Instead, some will be compelled to accept jobs for which no college training would be required, bumping a less trained job seeker onto the unemployment roles. This trend has already begun. Department of Labor data indicate that in 1970–71 less than two-thirds of American male graduates were able to find professional, technical, or managerial jobs upon graduating from college.[15] The rest went into clerical or service jobs (13 percent), blue-collar work (12 percent) or sales (11 percent). BLS data have revealed further that in the past five years the percentage of college graduates working as laborers and in craft and clerical jobs has skyrocketed.[16] From 1969 to 1975, the number of male college graduates working as salesmen increased by 50 percent and the number of women college graduates working as secretaries increased by 100 percent. Harold Wool has warned of the extent to which this problem already exists:

> Recent surveys have indicated that over one-third of American workers consider that they are already educationally "overqualified" for their jobs and that these workers have significantly lower levels of job satisfaction than other workers. An acceleration of these trends, in turn, can be expected to intensify problems associated with poor worker morale.[17]

To the extent that highly trained persons are trapped in jobs making limited demands on their abilities and training and offering limited rewards or prospects of advancement, they come to share the already common dissatisfactions of their blue-collar coworkers and of many women in white-collar work. Their better comprehension of these problems undoubtedly will give new stimulus to the halting efforts to reconstitute jobs and the work environment to enhance employee satisfaction. Some experts foresee that new telecommunications

[14] Joseph Froomkin, "Supply & Demand for Persons With Post-Secondary Education."
[15] U.S. Department of Labor, "Employment of Recent College Graduates."
[16] Cited in Phyllis Franck and Annette Kornblum, "Where Are The Jobs?", Parade, October 3, 1976.
[17] Wool, p. 29.

technologies (discussed in Chapters II and VI) will assist by offering unprecedented opportunities to design and locate work in new ways. They also could facilitate greater use of personally tailored work schedules.

The job shortage and consequent decline in college incentives may cause a drop in college enrollment in the 1980s, barring the continuation of inordinate overall unemployment rates, according to Dresch. The fraction of all 24-year-olds with college educations could decline from a peak of perhaps one-third in 1980 to 15 percent in the early 1990s. In conjunction with a 13-percent decline in the size of the college-age population during this decade, college enrollments over the period could drop by as much as 50 percent.

Thus, it would appear that the children of college graduates reaching work age over the next 25 years may find it difficult to achieve the economic and social status enjoyed by their parents, not to mention exceeding it. If so, this will be a traumatic reversal of time-honored tradition of vertical mobility through education. Furthermore, the traditional pattern of rising responsibility and earnings over the course of a working life for highly educated people may not materialize for many, and they may not enjoy the vocational flexibility that has existed in the past. Furthermore, with the tendency toward stabilization of population and the aggregate size of the economy, shifts in demand among industries and regions will tend to leave more people unemployed in declining enterprises and facing a need for radical career changes than has been the case in our traditionally fast-growing economy.

Dresch concludes his discussion of this subject with a dramatic statement of its implications for society:

> Thus, it can be reasonably anticipated that over the next 25 years opportunities facing cohorts of young people will deteriorate, resulting in downward shifts in the relative status of successive generations. In a traumatic reversal of historical experience, children born to persons entering adulthood in the 1950s and 1960s will, on average, experience relatively lower status than their parents.[18]

Saturated markets for highly educated personnel have been noted by others as well. Denis Johnston, head of the Social Indicators Project at the Office of Management and Budget, has stated that the single biggest problem in the future will be that of absorbing the worker—especially the educated worker—into the job market.[19] Karl Taeuber, a noted sociologist, warns that young adults who are products of the postwar baby boom will find opportunities for job advancement or changing to a new job severely limited. He concludes that:

> The baby-boom adults will discover they cannot achieve their expectations for a life style similar to the prosperity they grew up in. There may be cut-throat competition for upper-level jobs, an increase in white-collar crimes, widespread dissatisfaction with the lower-level jobs, and more mental-health problems.[20]

These projections by various analysts clearly have a strong basis in current data. However, they seem to assume that no new wave of innovation will generate rapid growth in education-intensive industries during the next generation to match or exceed the role played in the

[18] Dresch, p. 140.
[19] Cited in "Next 25 Years—How Your Life Will Change," U.S. News & World Report, Mar. 22, 1976.
[20] Ibid.

past generation by computers, other electronics, and xerography. Yet major new technical advances—for example, in electronics, telecommunications, and energy—may be in the offing that will to some perhaps inadequate degree mitigate these problems.

The Role of Education in Economic Growth

In examining the process by which investment in human capital enters the production process, Dresch finds that it is not an efficient stimulus to the progress of science and the process of invention, which can be more effectively subsidized directly. A pool of recently trained technical personnel, however, facilitates the adoption of technical advancements into production and other processes. The main economic function of such personnel, therefore, is to aid in reducing the gap between the average productivity of technology in use and that of the best technology available. A reduction in this gap, he argues, will provide a transitory increase in the rate of economic growth, although it yields little or no permanent increase in the underlying momentum of technological advance.

Investment in human capital to narrow the technology gap is not free. Only when the benefits of more closely approximating the best-practice technology outweigh the costs of education is greater investment in human capital warranted either socially or for the individual. Thus, there is some degree of technological lag that it is not economic to reduce.

Contrary to many analysts, Dresch argues that the tax laws discriminate in favor of human capital relative to physical capital, leading to overinvestment in education. His view of the role of education leads him to conclude that "the place of education (human capital) in a national growth policy must ultimately be considered tertiary and tenuous." To him, education is not an important aspect of growth policy, much less an auspicious cornerstone for such a policy. On the other hand, if already trained personnel are underemployed, they are potentially available to serve the function of absorbing technology at low social costs. An implication of the longer term congestion in this job market may be the desirability of retraining sizeable numbers of high-level technicians to aid in absorbing the specialized new technologies of the 1980s and 1990s.

Edward Denison, in testimony before the Committee, maintained that a decline in college enrollments would not seriously affect future growth prospects, because only a small part of education depends on a rise in the ratio of college graduates to high school graduates. He agrees with Dresch and with Richard Freeman, however, that education's contribution to growth will be diminishing:

> My expectation is that education will contribute less to growth in the future than it has since 1929, but that the reduction will be gradual. A decline of something like 0.1 percentage points per decade in the 1970s and 1980s may be a reasonable expectation.[21]

[21] Edward Denison, "Some Factors Influencing Future Productivity Growth," p. 13.

The evidence on job dissatisfaction lends support to the argument that education will contribute less to growth in the future.[22] When more highly educated workers bump less educated workers from their jobs, no increase in productivity occurs because the nature of the job is likely to remain unchanged. To the degree that the new worker experiences job dissatisfaction, productivity may actually drop. This led O'Toole to state that "increasing the educational attainment of the work force above a certain level, without concomitant changes in the structure of work to capitalize on the increased capabilities of workers, will probably have a slightly negative impact on productivity." [23]

Human Resource Development

No other suggestion received more emphasis by the participants in the Committee's investigation than the need for greater development and better utilization of human resources. This need was stressed especially by Strumpel, who argued forcefully that, if we want growth, "we must change our factor input and utilization so as to make more intensive use of amply available (human) resources while husbanding scarce (physical) resources." His basic contention was that whether or not the United States will succeed in maintaining growth depends largely on our ability to identify idle resources that can be used to produce output that conforms to people's evolving tastes and aspirations. The principal idle resource at present is the unemployment and underemployment of people.

On the demand side, Strumpel stated that we need a "differently composed basket of goods and services," since a main obstacle to growth in his view is rooted in the existing composition of final demand. Growth thus depends on our ability to shift our tastes to what we can produce in increasing quantity and quality and to "stop clinging stubbornly to the consumption and production patterns adopted in a different era and under different economic conditions."

This thesis was propounded also by John McHale in his paper for the Committee. He argued that demands will shift through changes in social attitudes and values toward less emphasis on wider consumer product ranges and more on human systems and service needs. With population growth declining, "(economic) growth may be less dependent upon increased resource demands but more on human resource development."

James O'Toole maintains that the liberal solution to the overeducation problem is not to curtail educational attainments but "to more fully develop and use the education, training, and talents of youth to serve not only the needs of employers, but the needs of the social system in general." [24] The first step, as he sees it, is to increase not only the quantity but also the quality of jobs.

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[22] The thesis that education will contribute less to growth in the future is not universally accepted. Daniel Bell, in particular, disagrees. He contends that a new and unique dimension in social affairs will be that "the economic growth rate of a post-industrial society will be less dependent on money capital than on human capital." To Bell, the long-range expansion of the economy will be limited by shortages in technical and scientific manpower.

[23] O'Toole, op. cit., p. 65.

[24] Ibid., p. 5.

He warns, however, that the traditional programs chosen from a "time honored laundry list"—vocational and technical training, public service employment, increased manpower planning, and so on—have not succeeded in the past in creating plentiful and rewarding jobs. They may not only be ineffective, but also inappropriate for the conditions of a post-industrial society. In short, they will not be capable of achieving what O'Toole calls "total employment," a condition in which everyone desiring a job could be reasonably sure of obtaining one that satisfies his or her personal needs. This cannot be mandated by government and can only be achieved by policies developed to create greater freedom of choice for workers.

O'Toole maintains that to create total employment, a series of private and public programs should be undertaken which would facilitate the withdrawal from the paid labor force of reluctant workers, help those who need or want jobs to acquire them, increase the mobility of workers, and make the job market more flexible. He suggested the following strategies:

Reduce institutional rigidities in the labor market such as seniority rules;

Remove government regulations in which employment is a prerequisite for social services;

Provide a program of mid-career worker training or sabbaticals;

Provide programs that allow workers to taper off before retirement;

Establish a system of domestic "Fulbrights" for people who would like to take a year or two away from their regular jobs to engage in some kind of public service; and

Provide human-depreciation tax allowances or employment tax credits linked to the ratio of employment to fixed plant and equipment.[25]

The Institute for the Future echoes this theme: "If ever there was a time for changing corporate organizational structures and reward patterns, it is now." [26] They suggested parallel organizational ladders, nonmonetary rewards and more flexible work schedules, and employment of part-time workers.

Movement in these directions already has begun, particularly in Europe [27] but also in the United States. Mankin has referred to a recent trend in which corporations are attempting to restructure jobs to make them more challenging, to allow workers to exercise more control over the design and pace of their work, and to give them the opportunity to produce a meaningful portion of the final product.[28] He feels that jobs restructured in such ways should tend to yield higher quality products.

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[25] Ibid., p. 87.

[26] Corporate Associates Program, "Population and Corporate Change," p. 5.

[27] Over the past three years, the Commission of European Communities has been developing an action program aimed at humanizing working conditions. Its major goals are to increase job satisfaction; to reduce isolation and boredom; to make work more meaningful and satisfying; to gradually eliminate physical and psychological stress and to improve safety and health conditions. To further these objectives the EEC created the European Foundation for the Improvement of Living and Working Conditions. In London, the Travistock Institute for Human Relations developed guidelines for work-reorganization projects. The emphasis is on the basic human needs for a variety of tasks, for a minimum length of work cycle, for social recognition, an identifiable function, and for opportunities for self-improvement and occupational upgrading.

[28] Donal Mankin, "Work, Leisure and Material Equilibrium," p. 4.

O'Toole has noted that American companies are taking many kinds of actions to enhance career and job flexibility and to develop human resources. These include:

(1) Increasing individualized career planning,
(2) Introducing flexible work schedules,
(3) Facilitating sabbaticals,
(4) Providing lateral transfers and temporary project assignments, and
(5) Establishing company schools.

The idea of a sabbatical for all members of the work force is an intriguing one. Preston Cloud and Emile Benoit, endorsed the concept in their papers for the Committee.[29] Since Cloud advocated a major new program of sabbaticals, he gave extensive details on its benefits. During one year out of every seven, an employee would go back to school or into special training or research programs to acquire new skills or to improve traditional skills. This would occupy 14 percent of the labor force during any given year, an amount substantially higher than the current unemployment rate. In addition to the benefit of sharply reducing unemployment, the program would prepare people with obsolete skills to undertake new tasks and would improve the outlook and performance of those who have grown stale on the job. Such a plan might also reduce job hopping and provide companies with a more stable, interested and motivated work force.

Though this proposal may seem radical or utopian at first, it has been applied in a number of specific cases. For some time, journalists have received Nieman and other full-year fellowships for schooling; the military has regularly sent promising young officers to civilian graduate schools; and several high-technology companies have given their key scientific and engineering people a year off to catch up on the latest in their fields. Based on the same principle, although for a shorter period, is the "extended break program" of the United Steelworkers. Beginning in 1963, senior production workers have been given thirteen weeks off for every five years worked.

A sabbatical program with the full scope of that described above was propounded by the Department of Health, Education, and Welfare in its 1973 report, "Work in America." It described for consideration a "universal worker self-renewal program" which would provide all workers with the opportunity to take "a six-month paid sabbatical every seven years or a one-year sabbatical every fourteen years." The authors felt this training-oriented scheme would "make lifelong education a reality." It was argued that its estimated cost of $22 billion a year would be offset by such factors as the increased productivity of retrained workers, the reduction in unemployment and its costs, and the savings from cutbacks in industry and government manpower training. As stated by former HEW Secretary Casper Weinberger:

"Particularly in these inflationary times, there is the anti-inflationary thrust of sabbaticals—through their potential to increase productivity, reduce featherbedding in declining industries, and reduce shortages of skilled manpower in advancing industries." [30] It was felt

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[29] Benoit put it in the context that the new emphasis on leisure and activities should result in shorter hours, sabbaticals for all who want them, adult education as a major activity and more labor intensive production, all of which would increase employment opportunities.

[30] Secretary Weinberger cited in "That Every American Should Get One Year Off in Every Seven," by Kenneth Lamott, p. 168.

that greater social as well as economic efficiency would result from an environment in which there would be constant education and training, great job mobility and widespread career changing possibilities.

Many companies already look favorably on the general concept of sabbaticals. In a recent poll of the 500 largest companies, 24 percent of the 266 respondents had some form of program they considered to be a sabbatical, while another 41 percent considered the idea a good one. Only 4 percent said that it was a bad proposal.[31] Proposals also have been made both inside and outside of Government for an amendment to the Social Security Act to permit a person to take a year or two year's worth of retirement benefits during one or two preretirement sabbaticals. This system would not only foster sabbaticals but also help to subsidize those who wanted to prepare for a second career.

Despite its far-reaching implications for the economic system, this proposal has received the general endorsement of two Nobel economists. Leontief maintains that the sabbatical "would be a proper way to take advantage of steadily rising labor productivity by enjoying more leisure instead of continuing to pile up material goods and despoiling in the process the environment." [32] He did not, however, think the idea was practical at the current time. Kenneth Arrow found the universal sabbatical to be an "attractive idea," for it "improves the chance of people getting into jobs more useful to themselves and society." [33] As for its impact on the economy, he projects an initial reduction in GNP but faster growth thereafter from this lower base.

Another example of a way in which human resource development in the future could be enhanced was given by Coates. He stated that the possibility of doing 30 percent of all work at home held forth many potential personal benefits (in addition to savings on fuel and automobiles) : greater availability of discretionary time for personal development, more intimate opportunities for cooperation within the family and with neighbors, and more cooperative teamwork for husband and wife, which could help in drawing together today's centrifugal family life. This type of scenario was supported in a statement by the Science Council of Canada, saying that "the increased use of telecommunications should lead to a decentralization of work places and could foster structural changes in land use, places of economic activity and population distribution." [34]

Though the private sector bears the primary responsibility for designing jobs that fulfill workers' expectations, Government has a role to play in mitigating disequilibrium in the job market. In recent years it has not played its role very well. Instead of acting to alleviate imbalance between the demand and supply for highly trained manpower, the government has amplified the current surplus. Government funded large expansion programs at institutions of higher learning through the late 1960's. In the early 1970's, when the harsh readjustment to changing demographic conditions already had begun, it cut back sharply on funds for research instead of trying to cushion the shock. Government's myopic approach to what are inherently long-run re-

[31] Poll results reported in Paul Dickson's article, "The Sabbatical (Not For Professors Only)," p. 262.
[32] Lamott, p. 69.
[33] Ibid.
[34] Science Council of Canada, "Canada as a Conserver Society: Resource Uncertainties and the Need for New Technologies," p. 61.

source allocation problems has exacerbated rather than improved the situation.

Changed realities demand an overhaul of the education and manpower policy-making process. The impact of the Federal budget on the future labor markets should be reassessed regularly. Trends in educational attainments and related job expectations and the number of challenging jobs being created should be monitored so that education and research policies should be determined in a manner consistent with long-term forecasts of manpower needs.

It would be foolish to concentrate on programs that address only one element of human resource development. A focus on education, work or leisure that does not integrate policy toward the other two activities is likely neither to engage public interest nor to solve pressing social problems. O'Toole charges that this is precisely what has happened. He says, "The broader and more important issues of how society could develop and use its most valuable resources have been lost in nitpicking debates over such narrow topics as job satisfaction, job enrichment, overeducation and career education." [35] Acknowledging their importance, he believes that resolving them in a piecemeal fashion will not lead to a greatly improved general level of development of human resources in society.

Fortunately, many people are beginning to think in this way. The developing viewpoint is that education, work, and leisure should be experienced as continuing strands running throughout each person's life. O'Toole has stated it as well as anyone:

> Current moves to break the lock-step in education that keeps many young people out of workplaces until their mid-twenties, to provide continuing education for adults, and to offer flexible retirement programs for the aged portend movement toward the flexible integration of lives and generations. Such an increase in freedom might well make work (and life) more enjoyable.[36]

[35] O'Toole, op. cit., p. ix.
[36] Ibid., p. 14.

IV. CAPITAL FORMATION

Concern has prevailed since the early 1970s that the United States faces a serious and chronic shortage of capital. In elucidating this controversy, however, a clear definition of the issues is necessary.

Capital formation requires two, often separate decisions. First, it requires a decision to save, i.e., to divert a portion of income from consumption or government uses, freeing up the corresponding real resources for private investment purposes. This decision may be made by households, by corporations (through retaining earnings), or by Government (through running a budget surplus in the national income accounts). Second, capital formation requires a decision to invest, i.e., to put the resources not employed for consumption to work producing capital goods such as houses, business structures, equipment, and inventories. In the process, some savings must be transferred to investors via financial institutions and capital markets.

An excess of saving over desired investment leaves some resources unemployed. An imbalance in the other direction produces resource scarcity, rising inflation, and higher interest rates. It is the role of Government (including the monetary authorities) to attemp to equalize national savings and desired private investment.[1]

Since 1975, savings have been greater than desired investment with a resulting recession in economic activity. At such a time, it makes little sense to increase incentives to save; what is needed is growth in investment (and/or in consumption). Some observers fear, however, that savings will not keep pace with investment desires in the future, either because of a declining propensity to save or because private desire to invest may increase sharply. If investment outstrips saving, policies should be applied to raise savings (including shifting the Federal budget toward surplus).

These issues have been examined for the Committee in several monographs and in hearings published recently. This chapter outlines these deliberations in detail. The following major conclusions emerge from the analyses:

1. Capital formation is but one of many influences on the rate of economic growth. Others include employment, working hours, education, improvements in resource allocation, and advances in knowledge and organization. Edward Denison, a senior fellow at The Brookings Institution, estimates that all types of capital contributed about one-fifth of the growth of U.S. national income from 1948 to 1969.

[1] Discussion of this subject is plagued by the fact that much terminology is used by the layman differently from its use by economists and national income statisticians. "Saving" to the economist is defined as the amount of current income remaining after consumption spending is deducted. "Investment" is defined as production and maintenance of business plant, equipment, inventories, other structures (including residential structures), and consumer durable goods. "Money capital" is not part of the "capital stock," which includes only physical plant, equipment, and inventories. Increases in cash balances may or may not add to the funds available with which to make investments in new capital stock. A salaried worker's "investment" in common stocks or real estate, moreover, does not qualify as investment to the economist, because it does not comprise an initial purchase of a new physical asset.

2. The United States faces no shortage of savings at present or in the near future. In fact, heavy underemployment of both labor and capital signifies inadequate spending, and the deficit (i.e., dissaving) by the Federal Government helps to support the economy by making up part of the spending shortfall in the private sector. However, the long-term decline in corporate savings accompanied by increases in personal saving requires improved vehicles to transfer funds to would-be investors via financial intermediaries and capital markets.

3. Nearly all analysts agree that the fraction of GNP going to business investment over the next several years will have to be somewhat higher than in the past decade if the Nation's goals for employment, productivity, domestic energy production, pollution abatement, and healthful working conditions are to be fulfilled. Most agree also that this rate of investment is within reach and within the range of past experience at times of full employment and rapid economic growth, provided that the Federal budget is near balance or in surplus under such conditions.

4. There are reasons to believe that investment in several basic industries, such as steel and electric power, will be less than was projected until recently, because of reductions in demand growth due to the revolution in energy prices and to policies being adopted to limit dependence on energy imports. Long-term demographic trends also imply questions about the future of basic industries.

5. Professor Robert Eisner of Northwestern University points out that corporate fixed investment is only about one-sixth of total capital formation, broadly defined, and argues that other types of investment (i.e. unincorporated businesses, residential capital, human capital, and investment in research and development) should not be disadvantaged in an effort to promote corporate investment. Denison remarks that an effort to promote a particular kind of investment probably will only shift resources away from other investment categories.

6. Tax preferences intended to spur investment have been of limited effectiveness, particularly in periods of slack demand. Corporate liquidity has been restored to adequate levels since the 1973–75 recession, but investment will remain weak until businessmen are convinced that the economy will achieve steady growth. Approval of new investment tax preferences would be ineffective and futile in the absence of a full employment economy and unnecessary or, indeed, inflationary in its presence. This does not argue against reductions in overall business tax rates in the context of a general tax cut.

7. The argument that the relatively low U.S. economic growth rate is traceable to the contrast between this country and others in the share of GNP going to investment is misguided. Investment is only one of several variables—some of which are more important—in determining growth rate differences. No conceivable increase in U.S. investment could close the gap between this country and others operating at substantially lower levels of productivity. In fact, the data do not even conclusively support the proposition that the U.S. has invested a substantially smaller share of its GNP when differences among countries in the relative prices of investment goods and other goods are considered.

Has Capital Formation Declined?

The belief has been promoted in some circles that saving and investment rates have declined in recent years and that the U.S. capital stock has become antiquated. Looking at the facts, however, one finds that private saving as a fraction of GNP has been quite stable, averaging 15.8 percent for the years 1948 to 1974. Denison shows that this fraction deviated from its average by more than one percentage point in only two of these years (to a high of 17.1 percent in 1967 and a low of 14.4 percent in 1969). He finds neither a rising nor a falling trend. Table IV–1, prepared by Barry Bosworth, at the time a senior fellow of The Brookings Institution, indicates that the average savings rate in the first half of the 1970s was slightly above its earlier levels. As the table shows, this increase was accounted for entirely by personal savings, while business savings declined slightly, as it had for the previous decade. Business has made substantial progress since 1975, however, in reversing the decline in savings.

TABLE IV–1.—PRIVATE SAVINGS AND ITS COMPONENTS

[Percentage of GNP]

	1956–60	1961–65	1966–70	1971–75
Private domestic saving:	15.9	15.8	15.8	16.2
Personal	4.2	3.9	4.6	5.3
Business	11.6	11.9	11.2	10.9
Capital consumption allowances	(9.5)	(8.8)	(8.7)	(9.4)
Retained earnings	(2.1)	(3.1)	(2.5)	(1.5)

Source: Barry Bosworth, "The Issue of Capital Shortages," in "U.S. Economic Growth from 1976 to 1986: Prospects, Problems, and Patterns," vol. 3, Joint Economic Committee, 1976.

Richard Ruggles, in his paper for the Committee, showed that the savings of the household sector over and above its pension and insurance contributions consistently fell short of that sector's net new investment before 1966, but that households have made substantial net savings available for use by the business sector since that time. This net disposable saving has resulted from the slump during most of this period in new home construction.

Bosworth and Denison also dispute the proposition that investment has declined as a fraction of GNP or that the U.S. capital stock is becoming antiquated. From 1948 to 1974, gross private investment was relatively stable around an average of 15.6 percent of GNP. Table IV–2 indicates that it rose slightly during the boom of the 1960s. It has shown mild cyclical fluctuations. Business fixed investment has averaged slightly more than 10 percent. The average age of the capital stock has fallen throughout the postwar period from 14.2 years in 1950 to 11.6 years in 1960 and 9.8 years in 1973. Investment dropped precipitously in the severe recession of 1975, however, and has been slow to revive.

TABLE IV-2.—GROSS PRIVATE DOMESTIC INVESTMENT

[Percentage of GNP]

	1956–60	1961–65	1966–70	1971–75
Gross private:				
Investment	15.5	15.2	15.3	15.0
Business fixed investment	9.8	9.4	10.4	10.1
Residential investment	5.1	4.8	3.8	4.5
Inventory change	.6	1.0	1.1	.5

Source: Compiled by Joint Economic Committee staff from the National Income and Product Accounts.

The United States thus has experienced no general decline in capital formation prior to the most recent recession. If capital had become increasingly scarce, moreover, one would expect interest and profit rates to rise. In fact, Bosworth shows that the returns to investment by nonfinancial corporations tended to decline through 1975 and that a falling share of GNP was paid in the form of earnings to this capital.

Recent work by Martin Feldstein also shows a persistent decline in adjusted returns to nonfinancial corporations in each decade since World War II from 13.5 percent to 12.4 percent and 11.2 percent.[2] His statistical analysis of the reasons for this downward trend, however, leads him to conclude that returns have not decreased in any secular sense. Though 1970 to 1976 has been a period of unusually low rates of return, even after adjustment for long periods of poor capacity utilization, he finds that the profits shortfall that remains is not inconsistent with the random fluctuations observed previously. This leads him to conclude that "the factors that contributed to the fall in the return during the early 1970s are likely to be transitory. . . ." Joseph Pechman confirms that interest income has risen since the 1950s by about as much as profits have fallen and that, consequently, total payments to capital have remained about constant.[3] In any case, no one to our knowledge has argued that returns to capital have risen over the long term, as one would have expected in the presence of growing capital scarcity.

Although capital formation has not declined, the average productivity of capital has fallen recently. From 1947 to 1966, the output-to-capital ratio increased at an average rate of 0.5 percent per year, while from 1967 to 1974, it fell at 1.3 percent.[4] Thus, more capital was employed per unit of output than during the first two postwar decades. The average annual increase in business fixed investment in the 1950s was 1.8 percent, and for GNP it was 3.3 percent, while in the 1960s these figures were 6.1 and 4.5 percent respectively.[5]

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[2] Martin Feldstein, "Does the United States Save Too Little," p. 116.
[3] Cited in "The Capital Shortage Issue," Washington Post, July 14, 1975.
[4] Henry Wallich, "A Near Term Look at the Capital Shortage," p. 542.
[5] Lawrence Barss, "Industry's Capital Needs Give More Importance to Wholesale Banking."

Numerous factors contribute to reducing the average productivity of capital. One could be that many investments have encompassed projects of lower productivity than were funded in less euphoric times. Another is the emergence recently of a broad family of new social investment needs that do not have the same productivity effects as conventional plant and equipment investments have had in the past.

The National Planning Association has suggested that the falling trend in capital productivity will continue, because of the increasing rate of equipment obsolescence.[6] Higher energy costs and efforts to reduce them will make many machines obsolete earlier than originally expected. John Woolley points in addition to declining productivity in energy extraction to explain the productivity declined.[7]

The extremely high interest rates of 1973 and 1974 and the ensuing deep recession naturally weakened the financial structure of the business sector and stirred apprehension in many circles that the United States was suffering from a shortage of capital. Many people semed to foresee a more or less chronic shortage of savings. This concern, however, was shortsighted. In the main, the illiquidity of that period resulted from a policy of extreme monetary restriction imposed to quell inflation and was resolved quickly when that policy was relaxed and the economy began to recover from recession.

Over the past two and one-half years, the financial resources and soundness of the corporate sector have recovered well. Savings of nonfinancial corporations have risen sharply relative to investment, resulting in a rebound in liquidity unprecedented in the postwar period. The ratio of cash flow to capital outlays rose from 58 percent in 1974 to 128 percent in 1975 and remained between 90 and 100 percent in 1976. The higher ratio stemmed from a big jump in capital consumption allowances, the largest cutback of inventories in the postwar period, and cutbacks in fixed investment. Even though the ratio was raised by the weakness of investment (the denominator), the level of cash flow itself was by far the highest in history. Cash flow of nonfinancial corporations (retained earnings plus capital consumption allowances) increased by over 40 percent in constant dollars from 1974 to 1976, after excluding inventory profits.[8]

Just as striking as this rise in internal financing is the improvement in the nonfinancial sector's balance sheet. From late 1974 to late 1976, the ratio of financial assets to short-term liabilities rose by 15 percentage points, the proportion of short-term to total liabilities fell by five percentage points, the debt burden relative to cash flow has dropped by 37 percent, and debt-to-equity ratios have been falling steadily in the first sustained series of declines since 1953.[9] A recent survey by Business Week showed that most industries continued to strengthen their capital positions in the first half of 1977.[10] Long-term debt now accounts for 32 percent of the total liabilities of major U.S. companies, and short term debt another 5 percent.

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[6] R. Dennis, "Clambering Into the Eighties," p. 57.

[7] John T. Woolley, "Production and Capital Allocation," p. 83.

[8] In 1976, nonfinancial corporations accrued nearly $107 billion for depreciation, almost three times the level of such writeoffs in 1966. Depreciation write-offs in 1966 were just over half of that year's $63 billion in business outlays for plant and equipment. In 1976, depreciation was 89 percent of the $121 billion in such outlays. The business news magazine, Forbes, concluded from these data that "Today's corporation earnings are better than they look." Forbes, February 1, 1977, p. 71.

[9] Otto Eckstein, "Economic Issues and Parameters of The Next 4 Years," p. 63.

[10] Business Week, "The Slow-Investment Economy," October 17, 1977, p. 72.

It should be recognized that this striking improvement in corporate finances has occurred while industry is operating at an average of less than 85 percent of full plant capacity. The improvement reflects stronger price-cost relationships than existed in the early 1970s. It augurs still greater strength in corporate finances as the economy makes its way toward fuller employment.

Future Capital Needs

Labor availability and job needs could be forecast in Chapter III based on statistics for the existing population that is or will be of working age over the next decade or more. Similar estimates of capital needs can be made, based on estimated requirements to replace existing capital plus allowance for economic growth and for the fulfillment of goals such as worker safety and pollution control. It is difficult, however, to foresee the rate at which existing capital will become obsolete due to future advances in technology or changes in the prices of labor, energy or other important inputs. Investment needs also are very sensitive to the future ebb and flow of business activity.

So-called investment needs often have been stated in terms of so many billion dollars by 1980 or 1985. It must be recognized that any projection of investment needs is based on a certain set of social goals. As Professor Gerard M. Brannon of Georgetown University emphasized in his paper for the Committee, each goal has its price and represents a choice made through the political process or set forth as a premise of the projection exercise. If the resulting investment needs are more than society is willing to finance, then fulfillment of certain goals will be somewhat delayed. In this vein, Walter Wriston, Chairman of Citicorp, cautioned during the 1974 capital scare, that investment objectives, like the spending desires of most households, will frequently exceed the availability means.[11] "Pick any year, compile a national shopping list of capital investment aspirations and the estimate of the financial resources to fulfill them would always fall short." This led him in 1974 to characterize the "coming capital shortage" as a kind of permanent optical illusion.

Several careful studies have projected, however, that total private investment will have to reach 15.5 to 16.4 percent of a growing GNP over the next several years to accompany the needed job creation, to sustain the long-term productivity trend, and to achieve the Nation's energy and pollution-abatement goals.[12] Four types of investment which will rise rapidly are environmental investment, health and safety investment, mass transit, and energy investment. For instance, energy investments, which averaged about $33 billion annually from 1971 to 1976, are projected to average $75 billion annually (in current 1977 dollars) over the next 10 years.[13] Thus the percentage of gross private domestic investment made by the energy industry would increase from 17 percent to around 22 percent. Investment probably

[11] Cited in "The Capital Shortage Issue," Washington Post, July 14, 1975.

[12] Barry Bosworth, James S. Duesenberry, and Andrew S. Carron, "Capital Needs in the Seventies," The Brookings Institution, 1976; also Data Resource, Incorporated, "U.S. Long-term Review" Summer, 1975; and Benjamin Friedman, "Financing the Next-Five Years of Fixed Investment," Sloan Management Review, Spring, 1975.

[13] Cordell Hull and Denis Slaviche, "Capital Needs and Financing Methods for U.S. Energy Expansion," p. 23.

will decline in housing, roads, schools, hospitals, and, perhaps, inventories. These investments are predominantly in the noncorporate categories.

An investment share above 15.5 percent of GNP has been attained in only two years since 1966; the average investment share from 1966 through 1976 was 15.0 percent. Business conditions were relatively poor during much of this period. Such investment levels have been reached or exceeded, however, during three postwar periods of healthy economic growth, i.e., from 1948 to 1951, from 1955 to 1957, and from 1964 to 1966. There is no reason to believe they could not be attained again under similar circumstances, but fuller use of existing capacity and prospects of steady economic growth are preconditions for this eventuality.

Most of this increase in the investment share would have to go for business plant and equipment. A 1975 study by the Department of Commerce concluded that nonresidential fixed investment would have to rise to about 12 percent of GNP from 1975 to 1980 from its level of 10.4 percent from 1965 to 1974.[14] Barry Bosworth, in testimony before the Committee, confirmed the Commerce Department's conclusions, calling its estimates representative of other recent projections. Bosworth agreed, furthermore, that accommodating this level of investment would not create serious difficulties for the economy. He pointed out that it would help to generate the overall demand to carry the economy back to full employment.[15] In conclusion, he states:

> The magnitude of the "capital needs" does not seem to be changed significantly by the recent recession. A consideration of needs would still seem to imply a rise in the share of GNP going to investment of about 1 percent of GNP.[16]

Today's problem, however, is not one of business investment demands outstripping the supply of savings. On the contrary, today's situation is one in which business is not committing itself to new investment projects that it recently regarded as urgent, even though it has adequate funds at its disposal. This hesitation arises primarily because the expected future growth in demand for basic industrial products on which the need for much of this investment was based now has become questionable. The shift in perceptions of capacity needs by manufacturing firms is shown graphically in Figure IV–1 below.

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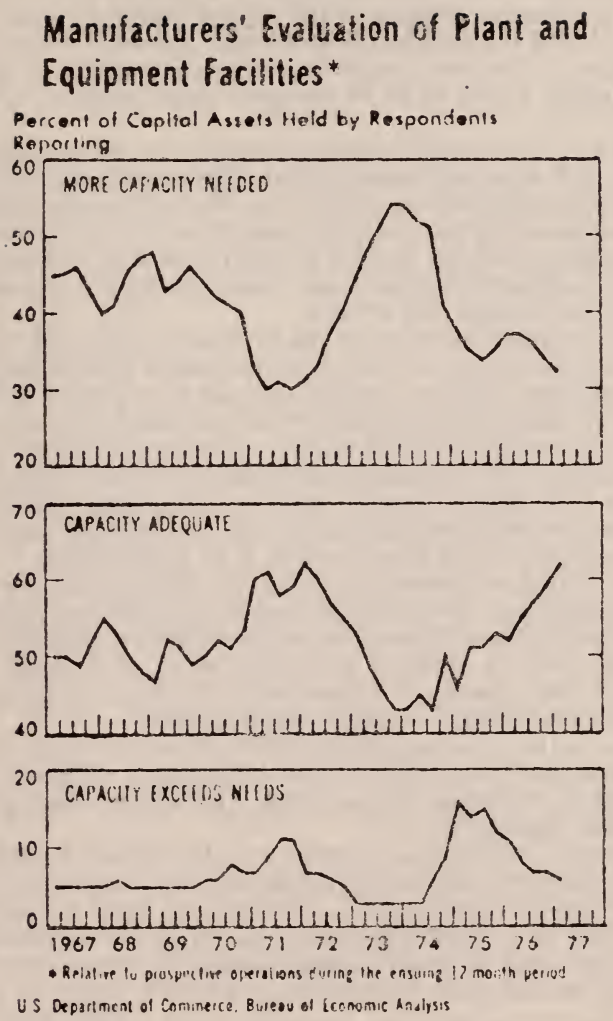
[14] U.S. Department of Commerce, "A Study of Fixed Capital Requirements of the U.S. Business Economy, 1971–1980," p. 7.
[15] Bosworth, p. 1.
[16] Bosworth, p. 4.

FIGURE IV–1.



Shifts in Economic Structure

The great increase since 1973 in the prices of raw materials, especially energy, and the resulting efforts to conserve these materials herald slower growth for the capital-intensive industries producing them. Moreover, the slowdown in population growth that already has occurred and the reduced rate of household formation foreseen for the mid-1980s imply that this decline in the growth of materials industries will not be temporary but instead may persist for a long period. This factor has not been adequately appreciated by those projecting investment needs.

The situation of the steel industry is a case in point. Among the foremost proponents recently of the capital shortage thesis, steel companies projected the need to invest billions of dollars annually as they raised prices in frequent, large steps. Capacity additions of 25 to 30 million annual tons (16 to 19 percent) were planned by the early 1980s.

At this very time, steel's major customers were projecting declining or uncertain future steel consumption. The radical reduction in automobile size, being made as part of the Nation's energy conservation effort, means a steady decline in steel purchases by the automakers, who in 1976 accounted for 23 percent of total U.S. steel consumption and over 40 percent of the rolled steel sheet. Auto steel consumption in 1985 will be well below that of 1973.

The half-hearted recovery of heavy construction activity also has undermined steel demand. This weakness stems from subdued investment in business plant and equipment and a very weak performance since 1973 in multifamily housing. Public investment is now benefitting from sizeable countercyclical public works expenditures, but this is not adequate to offset the slowdown in the other two categories. Meanwhile, the U.S. steel industry's pricing policies have rendered these flagging markets highly vulnerable to competition from imports, which in 1977 supplied nearly 20 percent of U.S. consumption.

The result of these circumstances has been lagging sales by American steel producers, poor utilization of capacity, and falling profits despite steady price increases. Rates of return have fallen to about half of their 1974 level. Now the industry has recognized that, instead of adding substantial new capacity, it is faced with the need to eliminate excessive capacity by closing a number of old plants.

Changes in the American automobile and reduced levels of business construction also weaken the prospective markets for many other materials. Among these are copper, lead, zinc, various steel alloys, synthetic rubber, and glass.

Thus investment in these sectors may be limited largely to those of a replacement and productivity-enhancing nature. Of the major metals industries, only aluminum continues to enjoy a strong demand outlook. Yet new aluminum plants may well not be located in this country but rather in those lands possessing large reserves of oil and natural gas as cheap fuels for the energy-intensive aluminum reduction process. Energy conservation measures in the United States also are slowing the growth in demand for oil and gas, curbing investment in energy refining, transportation, and distribution. The amount of gasoline used in the United States in 1985 will be less that it is today. Domestic energy extraction and conservation industries will continue their rapid growth, however, because of the drive to reduce imports. Future investment in electric power production, which currently lays claim to about 15 percent of all business investment resources, will depend on several developments: (1) the extent of conservation in response to higher electric rates; (2) the extent to which the Nation turns to electricity as a substitute for imported oil and scarce natural gas; and (3) the degree to which less capital-intensive, possibly decentralized technologies begin to supplant today's huge central station powerplants.

In these capital-intensive basic industries, where output scarcities and rapid capacity expansions recently were projected, it appears that the problem may be one of too little demand rather than too much. If financing for these industries is difficult, it is likely to be due to too much capacity—and the resulting low profits—rather than too little.

Intensifying concern that stagnation in the basic industries may prove to be a long-term problem is the fact that population growth in the United States has followed a downward trend for more than ten years. As noted in Chapter III, this trend is now being reflected also in the rate of labor force growth, which has declined from its peak rate of the early 1970s and will continue to fall steadily throughout the 1980s. Growth of the potential (i.e., full employment) labor force already has fallen from 2.2 to 1.8 percent per year and is projected to decline to less than 1.0 percent per year over the next decade. The rate of new household formation, with the related demand for all types of consumers' durable goods, will follow a similar pattern.

Fred Singer and Bradley Perry, in their paper for the Committee, argued that businesses actually could be better off with slower population growth, despite reduced aggregate sales and profits, because higher per capita income would mean greater sales per company or per establishment. This would be true, however, only if the number of establishments grows more slowly as a result of slower population increase. In any case, slower growth in household formation implies a shift in the composition of demand with reduced growth in markets for consumers' durable goods such as autos, refrigerators, kitchen and laundry equipment, furniture, and household textiles. It also augurs an eventual reduction in residential construction and in demand for construction materials, although much scope still exists at present for upgrading the quality of existing housing.

Singer and Perry emphasize, however, that the demographic outlook implies higher per-capita income, if the transition to slower aggregate growth is handled smoothly. Therefore, a larger share of the income growth will fall into the category of so-called "discretionary income," i.e., income remaining above that needed for essential food, shelter, and other basic requirements. They argue that increased discretionary income growth will provide larger markets for high quality goods and services and for new kinds of (typically luxury) products, stimulating business formation, investment, and technological advances in these fields.

Singer and Perry conclude that:

> This shifting of demand away from (beyond) today's bundle of goods and services would not necessarily hurt present business concerns, since the shifting, if very gradual, would provide ample time for businesses to adjust. . . .[17]

There is no reason why healthy growth should not continue to take place in some sectors, such as in the service industries and in those devising new products based on technical breakthroughs and innovations. Professor Carl Madden of The American University, in his paper for the Committee, anticipates this sort of structural shift. He writes:

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[17] Singer and Perry, p. 13.

We have to face up now to the need for changes in the pattern of investment in the next decade and beyond. . . . Already the pattern of consumer demand is changing from the demands of the first post-World War II generation for conventional durables to more emphasis on spending for travel, recreation, and experience. . . . Apart from the energy problem, today's generation of consumers appear less likely to use so large a part of their income for durable goods.[18]

Subsequently, he comments:

The structural shift in output and in industry growth will move toward getting more human value with less energy, materials, and pollution, in turn improving human effectiveness. . . .[19]

In fact, this pattern of development would merely accelerate the long-term shift that already has reduced the share of employment in the goods-producing sectors of the economy from 70 percent early in this century to about 30 percent today. Whether the adjustment can be made as painlessly as these authors imply remains to be seen.

The influence of slower growth in lowering national investment requirements should not be overstated, however, because the lion's share of gross investment in any year goes to replace existing capital. Working to offset the reduction in investment requirements due to slower growth will be an economywide tendency for rising energy prices to cut short the economic life of existing capital, accelerating replacement investments by both producers and households. Long and Schipper, in their paper for the Committee, emphasized this aspect of future investment requirements, stating that the United States "is entering a new cycle of capital investment which will have an energy and resource-conserving effect." They argue that national policy should accelerate this process to reduce the economy's vulnerability to increasing resource prices and constraints on resource supply. A similar chain of reasoning can be applied to the implications for investment of the prospective future labor shortages.

New research is needed to identify the nature and quantity of investment needs under today's new circumstances. All experts agree, however, that one should bear in mind the efficacy of the automatic market mechanisms in providing the incentive and the funds for true investment needs while withholding them from unwarranted projects. Probably more difficult than meeting capital needs for expansion will be the problem of sustaining the productivity and viability of firms and workers in industries facing long-term market declines.

The Efficacy of Investment Stimuli

Much legislation has been proposed to boost investment on the basis that this is needed to provide jobs and to enhance productivity. Many analysts, however, do not believe that greater investment in physical capital will serve these objectives effectively.

The bulk of the Nation's gross investment is undertaken to replace obsolescent components of the existing capital stock. To the extent that new facilities use labor more efficiently than old ones, which is usually the case, replacement investments result in an elimination of jobs, once the new facilities have been constructed and installed. In periods of slow overall growth, when few new jobs are being created through facility expansions, investment may eliminate more jobs than

[18] Madden, p. 26.
[19] Ibid., p. 27.

it creates. It is, of course, a contributor to the rise in productivity, which helps to restrain costs and prices, yields increases in per-capita income, and may be necessary to the competitive viability of the remaining jobs in the sector.

This conclusion was forcefully supported in the papers by both Strumpel and Denison. Strumpel foresaw substantial misallocation of resources if business investment were artificially stimulated to mitigate unemployment and other social problems. Given the complex and sensitive processes that make up research, invention, technology development, and innovation, he argued that there is little reason to expect a strong boost in productive efficiency from an extensive redirection of national resources to investment in private manufacturing. Denison, at the hearing, put it quite simply: "I do not think an increase in the investment share will be required."

Professor Solomon Fabricant of New York University argues that the growth of capital and growth in employment are not highly correlated in economic history.[20] In examining experience among countries, moreover, he finds no strong correlation between the overall stock of tangible capital in a country and its level of employment. Fabricant even questions the importance of physical capital to productivity growth. He stresses that an increase in tangible capital is a source, but not the only or even the dominant source of increases in productivity. Commenting on the argument that lower investment rates in recent years account for lower recent productivity gains, he cites a conclusion of the National Commission on Productivity and Work Quality that one cannot with any confidence assess the impact of tangible capital formation on recent productivity development.[21]

Many analysts doubt the effectiveness of tax preferences in boosting investment. A great deal of study has been devoted to this question in recent years. David and Scadding, after carefully reviewing the evidence, concluded in 1974 that the nature of individuals' responses to changes in taxes and in the imbalance of the Government's budget "leaves fiscal policy no scope to affect the accumulation of capital." [22] They contended that neither the level of taxation nor its composition significantly affects private saving or investment.

Many other scholars have reached substantially the same conclusion with reference to particular modifications of the tax structure. Looking at the effect of investment incentive enacted since 1954, Blinder and Solow concluded that "no consensus has yet emerged on the quantitative effectiveness of such fiscal devices in controlling plant and equipment purchases." [23] A 1976 study by Brimmer and Sinai stated that "the tax incentives provided only a modest stimulus to the overall rate of capital spending." [24] They suggested, as the Joint Economic Committee has consistently maintained, that a more effective strategy for enhancing the growth of physical capacity would be to pursue macroeconomic policies designed to raise aggregate demand and reduce the excessively high level of unemployment. Richard Musgrave supports this judgment that macroeconomic policy was the more effective tool

[20] Solomon Fabricant, "Perspective on the Capital Requirements Question," pp. 1–15.
[21] Fourth Annual Report, 1975.
[22] P. David and J. Scadding, "Private Saving: Ultrarationality, Aggregation, and 'Denison's Law.'"
[23] Allen Blinder and Robert M. Solow, "Analytical Foundations of Fiscal Policy."
[24] Andrew Brimmer and Allen Sinai, "The Effects of Tax Policy on Capital Formation."

for promoting greater investment.[25] Professor Robert Eisner of Northwestern University, in his paper for the Committee, stated, "The greatest threat by far to future capital spending is excess capacity and underutilization of existing human and capital resources."

Eisner points out the often overlooked fact that corporate investment in plant, equipment, and inventories is only part of the true business investment, which should be defined to include capital formation in the form of training and education ("human capital") and research and development. Furthermore, business investment is only part of total private capital formation, which includes outlays for residential capital and consumer durable equipment and should include individuals' outlays for education. Any valid measure of national investment also must include public investment in roads, airports, schools, parks, sewage treatment, and other social infrastructure.

Eisner argues, in fact, that corporate investment in plant and equipment has comprised less than perhaps one-sixth of total capital accumulation. Therefore, tax preferences favoring this form of investment alone discriminate against other important types of corporate capital formation and against the broad array of noncorporate investment. They tend to channel excessive funds into physical equipment and buildings at the expense of human capital and research.

Eisner also points out the link between the means of financing investment and the ownership of future capital:

> A prime issue in financing corporate investment, not often stated squarely, is that of ultimate ownership of new capital. Deductibility of interest payments for tax purposes, for example, encourages financing of investment by borrowing. The owners of additional capital then tend to be new bondholders. Accelerated depreciation and investment tax credits generate additional funds to corporations which enable them to undertake investments with less resort to the market, which means that current stockholders become the owners of the additional capital. Proposed measures to make dividend payments deductible on corporate income taxes would themselves raise after-tax corporate profits and hence increase the value of equity holdings by current stockholders.
>
> At the other end of the spectrum, a general cut in income taxes, which stimulates investment by raising the demand for output, would make some of those who save more out of their increased after-tax income owners of the additional capital acquired by business.[26]

In conclusion, the evidence makes clear that further tax incentives will not necessarily lead to increased investment or, if so, to a substantial rise in employment. When applied to an underemployed economy, they are likely to be ineffective; in periods of full employment such incentives will be unnecessary or even inflationary. Eisner contends that:

> Monetary policy and tax incentives directed toward affecting business investment, to the extent that they are successful in their narrow purpose, may merely change the mix of broadly defined investment without significantly influencing the total.[27]

Of course, this argument does not weigh against the need for general tax reductions which benefit corporations as well as individuals, or against "integration" of the corporate with the personal income tax.

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[25] Richard Musgrave, "Effects of Tax Policy on Private Capital Formation."
[26] Eisner, p. 29–30.
[27] Ibid, p. 17.

The vital question remains how to avert the stagnation of productivity in industries that may face secular declines in demand and production. Traditionally, such industries and their workers have had to make their own adjustments by reallocating resources and writing off their losses. Of course, nearly half of the undepreciated cost of facilities that are written off is recouped in savings on Federal taxes to the extent that a firm has other taxable profits. More important, declining industries have been replaced in the past by other new and growing sectors. If such a decline is now to affect a broad array of industries of economic and strategic importance, however, a more active government role in the adjustment will be called for. The time-honored method of tax incentive to stimulate investment probably will not suffice. A national or international plan for phasing out excess capacity may be needed. The nature of such government involvement, however, would have to be determined after a searching investigation and debate.

Projecting the Supply of Savings

Based on the current soundness of corporate finances, Allen Sinai of Data Resources, Incorporated, recently wrote that "no severe financial shortages will arise during the rest of this decade."[28] He believes that serious financial constraints would arise only if there were a sustained investment boom through 1980 accompanied by accelerating inflation and a prolonged dose of tight money. But Sinai sees a number of developments which reduce the likelihood of another credit crunch: A personal savings rate of 8 to 8½ percent is forecast (although it is yet to materialize); the cash flow of business, relative to expenditure, should remain strong; budget deficits at all government levels should diminsh as the recovery proceeds; innovations to improve the competitiveness of financial markets may occur, removing barriers to easy transmission of funds; and, finally, the great store of liquidity referred to earlier exists as a result of restructured corporate balance sheets. Sinai also has stated, however, that physical shortages of productive capacity may become more frequent as the decade unfolds. Bottlenecks and sporadic shortages of products may occur as full employment is approached. An appraisal by the National Planning Association concurred with this view.[29]

Taking a somewhat longer view, some economists, including Henry Wallich of the Federal Reserve Board of Governors and Professor Murray Wiedenbaum of Washington University (St. Louis), have warned that savings may not be adequate to meet the capital needs of the next decade. Wallich maintains that an inadequacy of savings rather than a surge of investment will create a shortage of investment funds.[30] As causes of this inadequacy, he points to the long-term decline in the share of corporate profits in GNP and the apparent trend of Federal as well as State and local budgets toward larger deficits. The essential conditions for an adequate flow of savings, according to Wallich, are a return of the profits share to levels attained earlier in the postwar era and a better saving performance on the part of the Government.

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[28] Allen Sinai, p. 56.
[29] R. Dennis, p. 40.
[30] Henry Wallich, "Is There a Capital Shortage–", p. 36.

In addition to this concern about declining profits, Wiedenbaum cites specifically his apprehension that a steady liberalization of social security and other government welfare programs will hold down the Nation's savings over the next ten years.[31] He also projects that demographic change will affect savings adversely. During the period, 1972 to 1982, the number of Americans in the high-spending, low-saving age bracket (20 to 34) is rising substantially, while the high-saving age bracket (40 to 54) is declining by two-million persons. Martin Feldstein of Harvard University has concurred with Wallich and Wiedenbaum in these judgments.[32]

Professor Gerard M. Brannon of Georgetown University, in a paper for the Committee, shows how in his view a higher savings share can be achieved through tax policy without sacrificing the progressivity of the tax structure. Brannon points out that the existing tax code is an ambivalent amalgam of conflicting provisions that both hinder and enhance saving:

> The U.S. has . . . a tax system which, so far as the basic structure and rates are concerned, is highly redistributive. At the same time, the political consensus regards this basic system as involving an excessive growth inhibition, and we more or less continually undercut the progressivity of the system by special treatment to encourage growth.[33]

Despite basically progressive taxes on income, inheritances, and real property, for instance, the tax code is shot through with special provisions to lighten its burden on saving and on investment incentives. There are reduced tax rates for capital gains, tax credits for investment in qualifying equipment, accelerated depreciation, and special preferences for investment income from mineral extraction, shipbuilding, timber, State and local bonds, housing, and certain other sectors. Preferential measures reduce taxes on investment income by over $30 billion per year.

This "schizophrenic" tax code serves neither the redistribution goal nor the growth goal well, according to Brannon. The progressivity of the system is undermined because tax preferences in the form of special deductions from taxable income yield tax savings in proportion to the taxpayer's tax rate bracket. In other words, the greater the income, the larger the tax saving. Progress toward the growth objective is hampered, moreover, because the many narrow and specific investment incentives in the U.S. tax code distort the allocation of investment from its efficient pattern by channeling excessive amounts into favored sectors at the expense of others. Eisner echoes this view.

Many economists agree that one change needed to rationalize the taxation of capital incomes is the "integration" of taxes on corporation income with the personal income tax. Both Eisner and Brannon emphasize the need to improve upon the present system. In addition to the double taxation of dividends, the uniform tax rate applying to corporate retained earnings burdens the low and middle-income stockholder's share of these earnings at more than his personal rate but the high-income stockholder's share at less than his personal rates.

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[31] Murray Wiedenbaum. "A Proper Concern for the Future: The Debate Over Saving, Investment and Capital Shortages," p. 5–6.
[32] Feldstein. "Does the United States Save Too Little?".
[33] Brannon, p. 4.

This inequity can be resolved in a number of ways. While this is not the place to go into the technicalities of an appropriate measure, it seems clear that a reduction of overall corporate tax rates and an integration of corporate and personal taxes, especially on retained earnings, should be two of the guidelines in designing tax reductions and reform.

As another means of lightening the tax burden on savings, Brannon favors the institution of a Federal value-added tax [34] together with a reduction in income tax rates sufficient to compensate each taxpaying household for the average amount of value-added tax paid by those in its income bracket. Refunds would be paid to households with incomes below the minimum taxable level. Such a change would reduce the tax burden on income saved while raising it on consumption spending without affecting the progressivity of the overall tax system. Brannon opposes substituting an expenditure tax altogether for the present income tax, because this would permit persons with large incomes to exempt large fractions of it from tax, thus sharply increasing the concentration of wealth.

Brannon contends that the savings of low and middle-income people would be sensitive to increases in the rates of return on saving. If his tax proposals were adopted, he believes, the existing welter of special tax incentives to investment could be abolished, because an increased flow of savings would result in lower interest rates across the board.

While this proposal to shift from direct to indirect taxation could help to increase the incentive to save, the staff questions whether the response of savings or of interest rates and investment would be as great as Brannon believes. More research on the interest sensitivity of small savers is needed. The proposal also would seem to have the great disadvantage of aggravating the inflation rate by inserting a new value-added tax into the cost structure. European countries that have introduced value-added taxes have experienced increased inflation rates. Such a change would be contrary to other current proposals to offset cost-push pressures by reducing sales and payroll taxes.

It should be emphasized that measures to increase savings would be inappropriate for today's underemployed economy, unless it is understood by the public that the Federal Government must act to offset the excess of private savings over desired investment that is expected to persist for some time. Needed today is not greater saving, but rather increased spending by consumers, investors, and/or government. Yet widespread understanding of this role of Federal budget policy has been very difficult to achieve. Greater overall savings will be welcome if and when the economy again reaches the range of full employment.

The Role of the Federal Budget

The proper management of the Federal budget is critical to the process of equalizing savings with investment to balance the national

[34] A value-added tax is levied on the value of each producers' sales receipts minus the cost of inputs purchased from other firms; a sales tax is levied on the gross receipts without this deduction.

economy. This means that the budget should shift toward balance or surplus when the strength of the private economy threatens to create resource scarcities and aggravate inflation. It also means that the Government must run deficits in times of inadequate or falling private demand that are sufficient to stabilize the economy and push it back toward full employment.

The belief is very widespread, however, that government deficits (dissaving) have caused national savings to fall short of investment in the past and are likely to do so in the future. This has led to the view that government borrowing has "crowded" private borrowers out of the capital markets, reducing private capital formation, driving up interest rates, and intensifying resource shortages and inflation.

The facts, however, do not sustain these propositions. Professor Richard Ruggles of Yale University, in a paper for the Committee, has provided a careful analysis of the behavior of savings and investment over six postwar business cycles. He writes:

> Recoveries generate more saving than can be absorbed by investment. Examination of the six recoveries since 1948 shows that at first the inventory turnaround and revival of fixed investment absorb the rapid increase in gross saving which results from rising profits and government revenues. As the recovery phase continues, however, saving continues to increase—largely because of a much faster increase in government revenues than in its expenditures—but experience shows that the increases in inventory accumulation and fixed investment soon slacken. As a consequence, demand levels off . . . and a new recession sets in . . . It is the excess, rather than the shortage, of saving which causes recoveries to abort.[35]

Eisner also takes aim at the theory that Government crowds private borrowers out, calling it fallacious. It is easy to see, for instance, that reducing the Federal budget deficit in an effort to leave more private savings for business investment may result—at times of weak private demand—in lowering national income and, therefore, in lowering business profits and personal savings. On the other hand, an increase in the deficit through cutting taxes could, under such circumstances, boost saving and investment and, after a certain period, result in a lower deficit than before the change.

In the past, the imbalance of the government's budget has reflected primarily the state of the private economy. The budget's automatic

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[35] Ruggles, p. 1–2.

stabilizers have tended to produce sizeable deficits during recessions and surpluses with true prosperity. Deliberate shifts in the budget imbalance have been small compared to these automatic changes. Even taking both automatic and discretionary changes together, however, fiscal policy has not been sufficiently vigorous in limiting instability.

The congressional budget process, first implemented in 1976, provides a means that could be used to take more effective control of the Federal budget for stabilization purposes in both prosperity and recession. Just as the Administration and Congress could move more firmly against unemployment during recessions, they should be equally ready to move the budget into the surplus range, if necessary, to avert inflationary scarcities when the economy reaches full employment. Under current practices, a year or more is often required to implement changes in fiscal policy.

Nothing is more vital to the achievement of greater investment nor to the maintenance of prosperity in general than better public understanding and acceptance of the importance of macroeconomic policy in balancing the economy and more timely implementation of policy changes by the Government. The view that fiscal and monetary policies have proven themselves incapable of stabilizing the economy is now widespread, but the truth is that such techniques have not been used effectively because of political and institutional obstacles to adequate and prompt implementation.

International Comparisons of Investment Levels

It has long been a concern of many that the investment share of GNP has been lower in the United States than in virtually any other industrialized country. It is argued that this is a major reason for the faster rates of economic growth abroad. Edward Denison, a leading analyst of the sources of economic growth, was asked by the Committee to examine the merits of this argument. His paper highlighted the reasons for differences in growth among the United States, eight European countries, Canada, and Japan over the 1948–69 period. The results of this examination are summarized in Table IV–3.

TABLE IV-3.—CONTRIBUTIONS TO SHORTFALLS FROM THE UNITED STATES IN NATIONAL INCOME PER PERSON EMPLOYED, 1970 OR 1960 [1]

[Percentage of U.S. national income per person employed]

Sources of difference	Northwest Europe [2]	Belgium	Denmark	France	West Germany	Netherlands	Norway	United Kingdom	Italy	Canada	Japan
Total difference	41.0	39.0	42.0	41.0	41.0	35.0	41.0	41.0	60.0	18.3	45.2
Total factor input	11.3	8.5	11.0	11.0	14.0	2.8	5.3	11.0	18.7	.7	10.6
Labor	1.1	1.0	2.8	1.0	2.5	−4.7	−.4	−.6	4.4	0	1.0
Hours of work	(−3.9)	(−3.2)	(−3.5)	(−4.1)	(−3.9)	(−5.9)	(−3.4)	(−3.1)	(−4.9)	(−2.8)	(−3.9)
Age-sex composition	(1.2)	(.1)	(2.2)	(1.1)	(2.3)	(−.9)	(.1)	(.7)	(.8)	(−1.6)	(2.3)
Education	(3.8)	(4.1)	(4.1)	(4.0)	(4.1)	(2.1)	(2.9)	(3.0)	(8.5)	(4.4)	(2.6)
Capital	9.7	6.9	7.7	9.6	11.0	7.0	5.2	9.9	13.8	1.3	8.4
Dwellings	(1.9)	(2.1)	(1.8)	(2.1)	(1.9)	(1.9)	(2.1)	(1.6)	(3.2)	(.2)	(2.9)
International assets	(.4)	(.3)	(.5)	(.5)	(.7)	(.2)	(1.0)	(0	(.6)	(2.0)	(.6)
Nonresidential structures and equipment	(6.6)	(3.5)	(4.8)	(6.1)	(7.4)	(4.8)	(1.5)	(7.5)	(8.7)	(−.7)	(3.6)
Inventories	(.8)	(1.0)	(.6)	(.9)	(1.0)	(.1)	(.6)	(.8)	(1.3)	(−.2)	(1.3)
Land	.5	.6	.5	.4	.5	.5	.5	.5	.5	−.6	(1.2)
Output per unit of input	29.7	30.5	31.0	30.0	27.0	32.2	35.7	30.0	41.3	17.6	34.6
Overallocation to agriculture	2.3	.2	3.1	5.8	3.7	−.2	6.1	−1.1	12.3	1.5	6.0
Overallocation to nonagricultural self-employment	.3	2.7	1.5	1.9	.4	1.1	2.1	−1.7	4.6	−.6	3.3
Use of shift work	.1	.1	.1	.1	.1	.2	.2	.2	0	NA	.2
Economies of scale [3]	4.9	5.9	5.7	4.8	4.7	5.9	6.2	4.6	4.5	5.2	3.5
Labor disputes	[4] NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	−.1
Irregularity in pressure of demand	−1.6	−1.8	−1.8	−1.7	−1.7	−1.8	−1.8	−1.3	−1.4	1.4	−4.3
Irregularity in agricultural output	0	0	0	0	0	−.5	0	0	0	0	0
Lag in the application of knowledge, general efficiency, and errors and omissions	23.7	23.4	22.4	19.1	19.8	27.5	22.9	29.3	21.3	10.1	26.0

[1] Data for Japan are for 1970. Those for all other countries refer to 1960. All data are based on comparisons in U.S. prices of the year compared.

[2] Includes Belgium, Denmark, France, West Germany, the Netherlands, Norway, and the United States.

[3] Includes size of local markets and national markets, and effects of barriers to international trade.

[4] Not available.

Source: Edward F. Denison and William K. Chung, "How Japan's Economy Grew So Fast," the Brookings Institution, 1976, pp. 96–97.

Of the 4 percent annual growth for the United States from 1948 to 1969, 0.8 percentage points were contributed by capital and 3.2 points by other growth sources, mainly increases in labor force, education, advances in knowledge, and economies of scale (which often are embodied in capital plant).

Denison showed that raising the growth rate of U.S. net output by a single percentage point through greater investment would have required an extra 11 percent of net output invested annually. This alone means that "it would be quite impossible to explain international differences of several percentage points in growth rates solely or mainly by differences in investment." [36] During that period, five other countries with relatively large economies had considerably higher growth rates than the United States. In Italy and France, capital's contribution was the same or smaller than in the United States and hence explains none of the difference in growth rates. For Japan and West Germany, the difference in the capital contribution amounted to 27 percent of the difference in growth rates, while for Canada it could explain 36 percent of the difference. The other large country, the United Kingdom, experienced slower growth than the United States and the capital contribution was smaller by an amount equal to 17 percent of the difference in growth rates. Thus, Denison's overall conclusion is:

> In no case where growth rates of the United States and another country differ considerably does capital account for as much as two-fifths of the difference. Usually, it accounts for much less than that, and in important cases it accounts for none at all.[37]

This result should not be surprising, as capital is but one of several important determinants of output. Denison identified a major growth source that has been more systematically associated with growth rates than has capital; namely, the reallocation of labor into nonfarm wage and salary employment from farming and self-employment in small, inefficient enterprises. Individual countries had particular sources important to their higher growth rates: employment growth in Germany, Canada, and Japan and an especially large increase in general efficiency in France, Italy, and Japan. Economies of scale were also important.

Denison shows that other industrialized countries enjoyed higher growth rates than did the United States largely because they were operating in a different environment. Conditions differed greatly with respect to the extent of initial resource misallocation, general efficiency, and economies of scale. The relatively low American growth rate was not an indication of poor economic performance but resulted from the facts that (1) similar changes produced larger percentage increases in national income in countries with lower income levels, and (2) there were opportunities to increase efficiency in other countries that did not exist to the same degree in the United States. Thus, the others did not really do more in any relevant sense to obtain growth. Denison summarized his findings with the statement:

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[36] Denison, p. 45.
[37] Ibid., p. 70.

We should not try to provide more generous investment incentives because some other countries may do so. We should not imagine that investment would be raised radically if we did. And we should not imagine that the growth rate of output would jump up to foreign rates if investment could be so raised.[38]

Indeed it may even be questioned whether the United States really has experienced a substantially lower investment-GNP ratio than other industrialized countries. The data normally used in international comparisons of capital investment fail to take account of the fact that the prices of capital goods compared to other components of GNP have been lowest in the United States. In fact, when GNP for other countries was restated at U.S. prices, the ratio of nonresidential structures and equipment to GNP was lower for the European countries than for the United States. This was because of the relatively low prices of machinery and esuipment. Denison concludes that:

The difference in price ratios is one of several reasons that international differences in ratios of investment to national produce are extremely difficult to interpret and almost impossible to relate to growth.[39]

[38] Ibid., p. 75.
[39] Ibid., p. 74.

V. NATURAL RESOURCES

Until recent years, natural resources were a virtually forgotten element in the conventional economic theory of production and growth. Economics focused almost exclusively on labor and capital. Except for the blandishments of special interests, policymakers also were unconcerned, because the resources needed for industrial growth seemed to be available in prodigious quantities and at relatively modest cost. William Nordhaus, currently a member of the Council of Economic Advisers, stated the situation succinctly: "For a considerable part of its history, the American economy . . . has been a cowboy economy in the sense that there have been no important resource constraints on growth." [1] In fact, basic minerals, including fuels, experienced a long-term trend of declining real cost for decades prior to the early 1970's.

Now, however, many observers believe that this long-term trend may have reversed itself, although they differ on the reasons why. In recent years, the marginal cost of new supplies of today's energy forms seems to lie significantly higher than average costs (with the possible exception of Middle Eastern oil). The costs of alternate fuels, such as synthetic gas or shale oil, lie much higher yet. The same may become true of other important minerals. In any event, the oil embargo of 1973 shocked the world and made questions of natural resource costs and supplies a central concern for economists, businessmen, and policymakers.

This chapter will highlight the findings of the Committee's commissioned papers and hearings on four critical questions: (1) Does the United States face serious resource scarcities which will significantly affect materials costs? (2) Do attractive possibilities exist to conserve scarce materials and substitute more abundant ones for them? (3) What is the relationship between economic growth and energy use? (4) What about the ultimate finiteness of the Earth's resources?

The main conclusions of this chapter are the following:

(1) No physical shortages of natural resources appear to threaten the economy's growth within the next ten years. Many economists believe that resources will pose no serious constraint for many decades beyond that time, although some increases in relative prices stemming from natural scarcity may exercise a drag on economic growth. Geologists and physicists typically are more concerned about materials scarcities within the next 50 years. Energy scarcity and large price increases imposed by the oil cartel could cause substantial disruptions of the world economy.

(2) U.S. demand for many materials is expected to grow more slowly than in the past or in some cases to stabilize in the final quarter of the twentieth century. Nonetheless, U.S. dependence on imported raw materials will continue to grow as it has over the past 50 years due to depletion of domestic deposits. Because of the cartelization of energy

[1] William D. Nordhaus, "Resources as a Constraint on Growth," p. 22.

prices and the drive for conservation, energy imports may be an exception. Worldwide demand for materials is expected to rise substantially by the year 2000, in part because of the rapid development of manufacturing in today's semi-industrialized countries.

(3) The future balance of materials markets depends, as in the past, on a race between depletion and technical progress. Throughout the industrial era to date, technical progress in extraction, processing and using industries has won this race. These advances will continue, but it cannot be taken for granted that economies from this source always will exceed cost increases stemming from depletion. Many prospects for conservation and substitution for scarce materials also exist, especially in the United States, where energy and materials have long been cheap.

(4) In the past, the growth in energy use has been tied closely to the growth of GNP. Energy use per dollar of GNP has declined gradually with progress in technology and the shift in output structure from heavy industries to lighter industries and services. Since 1973, however, sharply rising energy prices have stimulated efforts to cut energy input requirements, which doubtless will reduce the energy-GNP ratio more rapidly. Comparisons of energy inputs in the United States and other industrialized countries indicate that much can be done with proven technology, and the new price incentives and public research funding for energy conservation probably will yield technical breakthroughs in this area during the next generation.

(5) The finiteness of the Earth's mineral endowment and its implications for mankind's ultimate future must be recognized. Unless ways are found to derive serviceable energy from extraterrestrial sources (e.g. sunlight), man's economy sooner or later must decline. Whether this limit lies in the near or distant future, we have an obligation to future generations to adopt policies of prudence and conservation in resource use as we strive to find means to escape these constraints.

Resource Availability

The issue of resource scarcity often is phrased in terms of how long it will take to run out a material. This question is crudely formulated. There probably are no resources of which supplies will be totally exhausted within the next few decades.

The issue of scarcity is properly posed in terms of the costs of extracting certain resources in ever increasing amounts and thereby the prices at which they will be available. Depletion of nearby high-grade deposits means higher costs to obtain and refine more remote, lower grade ores. High energy prices and the need to convert to available domestic fuels impose substantial new costs on all materials refining industries in the United States and have focused new attention on the need to conserve energy in processing ores. Some analysts even suggest that the energy requirements may pose the ultimate limitation on materials supply. Potential political constraints on supplies also are a concern in a few cases.

Thus, the main issues are not those of exhaustion, but have to do with the terms under which materials will be available. Sterling Brubaker of Resources for the Future has stressed this fact in his book, "In Command of Tomorrow":

The concept of ultimate supply seems to vanish in the mist if applied to diffused mineral elements at low concentration. Moreover, unlike energy, which generally is irretrievably lost when used, all minerals carry the possibility of recycling, with relative cost playing the crucial role in determining whether they will be recovered. Mineral supply is very much an economic question, and a figure for the ultimate availability of mineral resources is not very illuminating.[2]

Despite this elasticity of materials supply, the burgeoning of worldwide demand, including that of many populous countries at an intermediate stage of industrialization, gives rise to concern about future price increases. For instance, a recent United Nations study, directed by Leontief, projected a tremendous growth in the world's consumption of minerals between 1970 and the year 2000. Even making liberal allowance for the use of new, materials-conserving technologies and for an increase in recycling, the U.N. study concluded that "the world is expected to consume during the last 30 years of this century from three to four times as many minerals as have been consumed throughout the whole previous history of civilization." [3]

The Next Decade

John McHale stated in a paper written for the Joint Economic Committee that predictions of impending scarcities or possible global exhaustion of material resources have "little basis in reality." He emphasized that "in overall terms, there are no foreseeable absolute scarcities which might constrain growth in the next ten years." [4] Both domestic and world reserves are ample for this period. The outlook indicates few substantial price increases other than those which may emerge through supplier collusion or international commodity price agreements. According to McHale, any supply problems that arise will be matters of costs, lead times, or politics, and not a result of physical scarcity.

William Vogely, a resource economist at Pennsylvania State University, also examined for the Committee the question of resource adequacy. He concurred with McHale about the medium-term outlook. Addressing the question whether the costs of extracting and processing the available resources may rise so sharply as to threaten the Nation's living standards, his answer for the period 1975 to 1985 was an unequivocal "no". For this period, Vogely could see no basis in geological factors for raw materials prices to increase relative to other prices.

David Novick, in his 1976 book entitled "A World of Scarcities," arrived at a less sanguine conclusion: "For the next decade or so," he writes, "the world's natural resources are not adequately developed to meet needs at the early-1970s requirements rates." [5] Even if the energy bottleneck is broken and rapid economic growth resumes, Novick foresees that the scarcities of other materials immediately will overtake us.

The Joint Economic Committee staff projects that U.S. consumption of several important materials will tend to stagnate or decline during the next decade. The influence of economic and demographic

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[2] Sterling Brubaker, "In Command of Tomorrow," p. 89.
[3] Wassily Leontief, "The Future of the World Economy," p. 22.
[4] McHale, p. 3.
[5] David Novick, "A World of Scarcities," p. 94.

trends on the demand for steel was discussed at some length in Chapter IV. Focusing on the decline in auto size alone, it is striking to note that motor vehicles in 1973 accounted for 63 percent of U.S. lead consumption (including fuel additives), 33 percent of U.S. zinc consumption, 64 percent of the rubber (mainly synthetic), and 21 percent of the steel. Since that time, American cars have declined in weight by about 15 percent (600 pounds per vehicle) and will shrink by perhaps 20 percent more by 1985.

Smaller auto engines will require smaller batteries containing less lead and zinc. Lead additives for gasoline, which comprised 21 percent of U.S. lead consumption in 1973, will be largely phased out. Many zinc castings in today's cars will be replaced with aluminum castings of lighter weight. Smaller, lighter cars also will require smaller tires and will get much better tire mileage through reducing stress and wear.

Assuming only a 10-percent weight cut for trucks and buses and 1990 vehicle sales little greater than today's, it is estimated that changes in motor vehicles would reduce total 1990 U.S. consumption of these materials by the following amounts relative to 1973: lead, −31 percent; rubber, −15 percent; zinc, −8 percent; steel, −5 percent. Declines in the markets for other durable goods during the 1980s may add to these effects.

These declines in U.S. demand for several important materials, even if not mirrored in other countries, will relax markets for these commodities over the next ten years. It will delay the appearance of capacity bottlenecks and restrain prices during this period. It has only limited effects, however, on the outlook for the longer run, because growth in other categories of demand can be expected to continue.

The Longer Run

There is much less agreement among the experts concerning the longer run. McHale and Vogely are optimistic. McHale writes that available data on world reserves of major metals and other minerals suggest that these are ample in almost every case for the next 25 to 100 years. The main conclusion of Vogely's paper stated the matter quite forcefully:

> Certainly within the time frame of 1975–85, and with only slightly diminished certainty within the time frame 1975–2025, the physical characteristics of materials availability will not cause any increase in the real costs of materials to the world economy. Thus, physical constraints on production of materials are not a threat to continued economic growth.[6]

Vogely added that this conclusion is even more clear when one considers the probable continuation of the technological progress, which yielded the historical decline in real resource costs and the possibilities for substituting abundant for increasingly scarce materials. Thus, Vogely is confident that the long-term trend of declining real cost for material resources will not be sharply reversed.

Certain other recent studies support the conclusion that future economic growth, particularly over the next decade and perhaps out to the year 2025, need not be hampered by natural resource depletion. The Report of the National Commission on Supplies and Shortages, issued in 1976, concluded:

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[6] Vogely, p. 82.

The geologic, economic, and demographic evidence indicates that no physical lack of resources will seriously restrain our economic growth for the next quarter century and probably for generations thereafter. Judging by past trends, the estimates of most reserves will increase; for the few cases in which crustal exhaustion is remotely likely, there will be sufficient warning for adjustments.[7]

An assessment by the Edison Electric Institute concluded that "natural resource availability could, but need not present a constraint to continued economic growth." [8] It also emphasized, however, that shortages and rising costs of relatively scarce resources will bring major changes in the patterns of resource use and will alter the future directions of growth.

The United Nations study referred to above stated the optimistic conclusion clearly:

Known world resources of metallic minerals and fossil fuels are generally sufficient to supply world requirements through the remaining decades of this century, and probably into the early part of the next century as well.[9]

It found only two metallic minerals, lead and zinc, which are expected to "run out" by the turn of the century. This adequacy of the world endowment, however, does not necessarily ensure against regional shortages or higher prices, nor does it guarantee a smooth transition to dependence on shale oil, gasified coal and other "new" energy sources.

Professors Preston Cloud and Allen Kneese, in their papers for the Committee, disagreed sharply with this relatively optimistic assessment. Cloud, a geologist at the U.S. Geological Survey, states that only a few metals are so abundant that technological advances will assure their continued availability. Among these are iron, aluminum, and magnesium. He stresses that recurrent shortages for many other materials and worldwide economic depletion for some can be predicted within the first half of the 21st century. Global shortages of antimony, bismuth, copper, gold, and molybdenum can be expected beyond the first third of the 21st century, and petroleum, natural gas, and helium will be gone by mid-century, according to Cloud.

Domestically, many resources will be either non-existent by 2050 or so localized and limited that little prospect will remain of new domestic discoveries. This forecast applies to tin, commercial asbestos, columbium, fluorspar, sheet mica, high-grade phosphorous, strontium, bismuth, the platinum group metals, mercury, molybdenum, and perhaps chromium and nickel. Most of these materials, however, are almost exclusively imported today.

A critical component of Cloud's conclusions regarding long-run resource scarcity is the concept that declining ore grades will increase dramatically the amounts of scarce and costly energy required to extract and refine various minerals. He posits the existence of a sort of energy boundary that will limit the economic availability of some metals. He states:

For most mineral commodities, it is more likely that the next half-century will be marked by temporary shortages and dislocations than depletion, in the sense that grade of ore will decline to levels where approach to the energy boundary and other costs of mining and extraction will exclude them from the market.[10]

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[7] The National Commission on Supplies & Shortages, "Government and the Nation's Resources."
[8] Edison Electric Institute, "Economic Growth in the Future," p. 60.
[9] Leontief, p. 24.
[10] Cloud, p. 72.

There are a few minerals for which presently known world resources are inadequate to meet projected world demand in the long run. Important minerals in this category include zinc, lead, and copper and magnesium. Some new resources may be found. In some cases, available supplies may be extended enormously by going to much lower quality sources, but then the production processes become much more costly and energy-intensive. Thus, Allen Kneese of the University of New Mexico concludes that "we most likely face a future of rising or at best stable relative prices of most important nonfuel minerals rather than the decline we have seen historically." [11]

Two basic opposing forces are at work affecting the extent to which resource costs may rise. The first is the application of new technologies which continually increase efficiency in extracting and using resources. Because of the record of increasing efficiency in the past, Professor Harold Barnett argued in his paper for the Committee that the law of diminishing returns has presented no constraint on the use of materials.

On the other hand, as a result of continuing resource depletion, given inputs of labor, capital, energy, and other factor inputs would yield less output of energy and resources with any given technology. Thus, the economy would experience increasing relative prices for minerals due to falling productivity of extraction and refinement were technical progress not adequate to offset the costs of tapping deposits of lesser grade in more remote locations. Growing use of resources and energy then would become hard to sustain.

Thus, the economics of mineral industries features a continuous race between technical progress and the depletion of our resource endowment. Up to now, technology has won this race. It is not possible, however, to specify which force will be more powerful in the future. It is likely that technological advances will be sufficient to keep productivity in resource and energy extraction from falling over the next decade. It cannot be taken for granted that this will always be the case.

A. G. Chynoweth, Director of the Materials Research Laboratory of Bell Labs, expressed the judgment that supply additions may not be adequate for the long term:

> These constraints are not likely to go away very easily, particularly on the energy front, and so we had better accept that for the foreseeable future we must practice a policy of materials conservation. At present we are probably in a transitional phase in which society's reaction to material shortages is to try both to increase supply and to reduce demand for new materials at the same time; but reducing demand for virgin materials through various conservation measures may well be the main policy in the future.[12]

In appraising these arguments, it must be recognized that any evaluation based on the present and recent past may tend to engender undue pessimism. Reserve estimates are no guide to the ultimate supplies of materials available, for they include only those that have been commercially proven. Potential discovery of new resources and of cost-reducing technology to process them are intrinsically hard to anticipate. Demand forecasts based on recent trends may be exag-

[11] Kneese, p. 152.
[12] A. G. Chynoweth, "Materials Conservation—A Technologist's Viewpoint," p. 36.

gerated, because the potential for conservation, substitution and recycling is difficult to appreciate at a time when a long era of declining relative resource prices is being supplanted by an era of increasing relative prices.

Import Dependency

Though worldwide shortages of most minerals will not occur soon, the U.S. domestic resources of many are so limited that the issue of import dependency has become controversial. One of the few optimistic statements on this subject is that of the National Commission on Supplies and Shortages, which contended that the growth in petroleum imports has fostered a misconception about other minerals. Aside from petroleum, the Commission said, our dependence on imports has increased only modestly. "It is simply misleading," they say, "to cite a U.S. 'deficit' in the minerals trade as though this represented in some pertinent sense a national loss." [13]

While our dependence may not have been growing in recent years, it certainly has grown when viewed over the perspective of the past few decades. Imports of iron ore went from 2 to 3 percent of U.S. production in the 1937–1941 period to levels greater than 50 percent by 1975. The Bureau of Mines has reported that the United States is highly dependent on imports of several lesser minerals: [14] mica (100 percent), manganese (99 percent), cobalt (98 percent), chromium (91 percent), asbestos (86 percent), bauxite (85 percent), tin (95 percent), mercury (73 percent), nickel (71 percent), and zinc (64 percent).

Brookings Institution has projected that by the year 2000 the United States will be totally dependent on foreign sources for 12 basic raw materials: [15] bauxite, chrome ore, copper, lead, manganese, nickel, sulfur, tin, tungsten, zinc, phosphorus, and potassium. More generally, the Bureau of Mines has projected that, by that year, the country may have to get more than half of its nonfuel minerals from abroad.[16]

Substitution and Conservation

The second question to be addressed concerns the possibilities for conservation and substitution for minerals and energy sources that become increasingly scarce and costly.

That the United States has a great potential for conservation is undisputed. It has been rated lowest in the effectiveness of its energy conservation efforts among the 18 members of the International Energy Agency. Popular support for the concept of conservation was illustrated by a 1975 Harris poll in which 90 percent of those polled agreed to the statement:

> We here in this country will have to find ways to cut back on the amount of things we consume and waste.[17]

The most straightforward way to conserve is to reduce demand for a materials-intensive product or service. As Charles Birch of the University of Sidney has pointed out, "to increase the life span of a nonrenewable resource, the payoff of quite a modest reduction in the *rate*

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[13] National Commission on Supplies and Shortages, "Government and the Nation's Resources."
[14] U.S. Bureau of Mines cited in The Wall Street Journal, February 14, 1977.
[15] The Brookings Institution material was cited in Stanley J. Modic, "Our Dependence on Imported Materials."
[16] Ralph C. Kirby and Andrew Prokopovitsh, U.S. Bureau of Mines.
[17] Philip H. Abelson and Allen L. Hammond, "The New World of Materials," p. 634.

of increase in its use is equivalent to a massive upward revision in the size of the stock." (Italics added.) Talbot Page of Resources for the Future has listed four other means of conservation and waste control.[18] One is designing for durability, increasing the lifetime of products. A second is cutting waste generation in production, i.e., reducing the volume of scrap in the production process. A third method is cutting the amount of material embodied in the product. The fourth method is recycling, which Page feels has received too much attention relative to the other three. The potential of each of these processes depends upon developments in technology, economic incentives, changes in lifestyle, and changes in product specification.

The goal should be to attain an efficient balance among the four. According to Page, "to the degree that market inefficiencies are eliminated, these four factors will simultaneously be brought into proper balance one with another." [19]

Each of these four means of conservation, particularly designing for durability and reduction in the material content of products, relates to the broader concept of substitution for scarce forms of materials and energy. The general agreement about possibilities for substitution among the experts testifying before the Committee was expressed by Vogely:

> The process of materials substitution is extremely complex and the traditional economic theorem that it is a function of relative price is inappropriate to understand the process.[20]

This traditional theorem is inadequate since relative prices may be only one of a number of major considerations in the complex process of discovering technical possibilities for substitution and implementing them.

In many cases, the dominant engine of materials substitution is the development of technology. A principal area in which this has been demonstrated is in communications, where technology development has significantly reduced materials requirements through solid-state electronics, microfilms, microwave transmission, and commercial satellites. This has been referred to as functional or system substitution in which a completely new way is found to perform the function of a component or system. The transistor, for instance, requires perhaps one-millionth of the material needed to make the vacuum tube it replaces. In another example, optical fibres may in the future reduce the demand for copper and aluminum wire.

The importance of this type of process has been increased by the quintupling of oil prices since 1973 and the concomitant sharp increases in the prices of most basic metals and other raw materials. In fact, Chynoweth maintains that "the area of functional substitution will perhaps be the prime determinant of what our future way of life will be like." [21]

Important in the process of materials substitution is the comparative attractiveness of competing material not only in terms of price but also in terms of other factors such as stability of supply, ease of workability, and tradition. Since raw materials are usually a relatively small

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[18] Talbot Page, "Conservation and Economic Efficiency: An Approach to Materials Policy," pp. 19–20.
[19] Ibid., p. 20.
[20] Vogely, p. 82.
[21] Chynoweth, p. 39.

portion of the total cost of the final product, nonprice attributes of the material and their effects on other costs may well outweigh price differentials between the competing inputs.

Technology will not always permit an alternative material to be substituted for one that is becoming scarce nor generate the needed functional substitution. In general, the more technically complex the material's application or the equipment it is used in, the more difficult it becomes to find a substitute. Palladium, for example, is the only material which gives adequate performance in electrical relay contacts in the telephone system. In other cases, substitutes may incur more frequent repairs. Many substitutions can be effected only at higher costs; otherwise the substitute would have been used in the first place. This is true, for instance, of oil from shale, gas from coal, and aluminum from nonbauxite materials.

Another cautionary note concerns the time required for substitution to take place. A study by Lynn found that, from 1945 to 1964, the average time from basic discovery to the beginning of commercial development was nine years, and the period of commercial development extended for an additional five years for a total introduction time of 14 years.[22] Equally important in determining the total time to implement a feasible substitution is the interval required for diffusion of a process throughout an industry. A recent international review of this question which examined ten new technologies reported that, as a rough generalization, a market penetration of 50 percent occurs in a period equal in length but additional to that needed for incubation and development.[23] Hence, Long and Schipper, in their paper for the Committee, concluded that:

> The total time required for effective substitution via technological change rather than price induction—following identification of the potential scarcity and invention of an appropriate substitution technology—is on the order of 25 to 30 years when diffusion time is included.[24]

Unfortunately, the evidence regarding substitution of other inputs for energy is sparse, and the few recent studies are conflicting. An econometric study by Berndt and Wood indicated that there are opportunities to substitute other inputs for energy.[25] They found that labor and energy are substitutable for each other to some extent. This could mean more intensive maintenance and monitoring of energy-intensive processes. They also found that present price ceilings on certain energy forms and investment tax subsidies which reduce the cost of capital tend to generate increased demand for both energy and capital. This analysis suggests that, in the present era of scarce fuels and high unemployment, these policies should be replaced by policies that exploit the potential for substituting labor for energy and capital. Long and Schipper concluded, somewhat in contrast to Berndt and Wood, that the substitutability of labor for energy is slight in our economy. They suggested, however, that the potential for such substitution be

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[22] F. Lynn, "An Investigation of the Rate of Development and Diffusion of Technology in Our Modern Industrial Society." "Report of the National Commission on Technology, Automation and Economic Progress, 1966."

[23] L. Nasbeth and G. F. Ray, "The Diffusion of New Industrial Processes : An International Study," 1974.

[24] Long and Schipper, p. 94.

[25] Ernst Berndt and David O. Wood, "Technology, Prices and the Derived Demand for Energy."

explored by conducting quantitative evaluations of specific technologies.

Part of the response to higher energy prices, of course, is to accelerate the shift in the composition of the economy's output from capital and energy-intensive basic manufacturers toward fabrication and services. Even within the so-called services sector, which is generally considered to be less materials- and energy-intensive, however, certain subsectors such as transportation, utilities, and recreation use these inputs heavily. Analysis by Hans Landsberg of the 1970 National Income Accounts revealed, for example, that an estimated $39 billion of consumer expenditures for recreation contained $17 billion for durable goods and $11 billion for nondurables, while only the remaining $11 billion—less than one-third—were classified as "services" proper.[26]

Regarding substitution of capital for energy, Long and Schipper conclude that new facilities can and will be substituted if energy's scarcity is reflected in its price. In addition to the replacement of old, inefficient facilities, this can take the form of conservation equipment such as insulation, heat recoupers, and automatic energy monitoring devices. Humphrey and Moroney found that capital and labor are equally substitutable for natural resources in the processes of five of seven two-digit industries studied.[27] As noted by Berndt and Wood, however, capital and energy have a complementary relationship in many industrial uses, and these may outweigh the substitution possibilities in the overall sense. Hudson and Jorgenson carried out an analysis for the economy as a whole similar to that of Berndt and Wood for the manufacturing sector.[28] They point out that, despite limited substitutability in the manufacturing sector, energy and capital tend to be substitutable on an economywide basis, indicating substantial opportunities for conservation through installation of more energy efficient equipment.

Long and Schipper contend that the issue of consequence is not the past relation between these factors, but that which can be expected to evolve with the introduction of new facilities. To gauge the potential, they examined production facilities in Europe, particularly West Germany and Holland, and in Japan, where industrial plants incorporate numerous technological advances over the older U.S. capital stock. Energy requirements for production of primary aluminum, cement, and polyvinylchloride (PVC) in these countries led to their conclusion that new capital facilities can and will substitute for energy. Thus, they postulate a "new cycle of capital investment" in the United States stemming from the energy price rises.

The most basic question of materials policy, according to Talbot Page, is:

> After two centuries of favoring materials extraction, should we now take active steps towards a more conservative materials policy, and if so, how?[29]

Amory Lovins has examined most of the influential studies in recent years and concluded that conservation is not merely an environmentalist's war cry but a highly economic energy path to take.[30] It does

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[26] Hans H. Landsberg, "Materials: Some Recent Trends and Issues," p. 638.
[27] D. B. Humphrey and J. R. Moroney, "Substitution Among Capital, Labor and Natural Resources Products in American Manufacturing."
[28] Edward A. Hudson and Dale W. Jorgenson, "U.S. Energy Policy and Economic Growth, 1975–2000," p. 461.
[29] Page, p. 4.
[30] Amory Lovins, "Energy Strategy: The Road Not Taken."

not come free, for investment in better equipment must be made in pursuing it. An investment in conservation, however, is generally cheaper than investments in new energy supplies. Except in the Middle East, capital investments of $4.5 billion in new oil or gas wells are required for every quadrillion Btu's (quad) of annual output. Synthetic oil and gas from coal probably would require investments of more than $10 billion per quad. New electric power plants range anywhere from $45 billion per quad to nearly $90 billion for nuclear facilities. By contrast, investments in capital equipment to save energy can run less than $1.5 billion per quad.

Lovins also stresses the large potential for conservation. "Technical fixes" alone, he feels, could improve energy efficiency by a factor of at least three or four in the long term. In building construction, technical improvements can save 50 percent or more in office buildings and 80 percent or more in some new houses. Another area of great potential is "cogeneration," the generating of electricity as a by-product of the process steam produced in industry. According to a study directed by Paul McCracken, U.S. industry by 1985 could meet approximately half its own electricity needs by this means, compared to about a seventh today. This rate of cogeneration would save fuel equivalent to 2 to 3 million barrels of oil per day as well as investments of $20 to $50 billion. Companies seem to have determined already that revolutionary methods of conservation and substitution may be attractive. According to Business Week, for instance:

> Scientists at a half dozen other respected companies, including General Electric Company, are also sketching windmills these days. Elsewhere in the white-smocked reaches of the nation's corporate laboratories, researchers are trying to squeeze power from ocean heat, design hollow ball bearings to cut auto weight, and convert wood chips from logged-over forests into fuel oil. Such projects, implausible or even ludicrous just five years ago, are evidence of the most far-reaching transformation to hit company research labs in more than a decade: Energy worries are sparking a basic reorientation of corporate research and development.[31]

Long and Schipper believe that the United States faces a critical challenge concerning how to maintain a rising standard of living under resource constraints that may impair economic growth. They expect the numerous possibilities for resource substitution to help to mitigate these constraints. Conservation practices will come naturally over time as a rational adaptation by producers and consumers to rises in the costs of using resources and to better information regarding the longer-run social consequences of doing so.

The Relationship Between Energy and Growth

It is often thought that GNP growth requires more or less proportional increases in energy use. Historically, from 1947 to 1973, energy use rose at an average annual rate of 3.1 percent while GNP rose at a 3.9 percent rate. In this period, the energy-GNP ratio fell from 106,600 to 90,000 Btu's per dollar of GNP (in 1958 dollars), a decline of —0.6 percent per year. This decline was substantially faster for much of the period, running at —1.2 percent from 1947 to 1966 and also from 1970 to 1973. After examining these facts, John Myers of the Conference

[31] Business Week, "Energy Conservation's Impact on R&D," p. 52.

Board labeled as the most striking characteristic of postwar energy use the fact that the savings took place in energy per dollar of GNP while energy was becoming ever cheaper relative to other goods.[32] (Energy prices fell by 24 percent relative to other prices from 1947 to 1970.)

What were the major contributors to this rise in what Myers has called "the productivity of energy" since World War II. Myers attributes it to technological change. A study by Resources for the Future showed that growth in GNP began to exceed that of energy consumption after World War I because lighter manufacturing and service industries started accounting for a greater portion of the Nation's business.[33] Ross and Williams, in a paper for the Committee, concluded that the reduction in the energy-GNP ratio for the period 1947 to 1967, "can be attributed largely to the efficiency improvements in basic materials processing industries and to the shift in manufacturing from basic materials to fabrication." They expect that the continuing trend in this direction will lead to further reductions in the ratio.[34]

The important point for the future is that the relationship between economic growth and energy growth will be modified through the new conservation and substitution measures discussed in the previous section. Long and Schipper illustrated the possibilities by comparing energy consumption among countries having equivalent standards of living. Their study of energy use in Sweden and the United States indicated that equivalent standards of living can be attained with energy use per capita and per unit of production much lower than current U.S. levels. They stressed that energy needs in the long run may be far more flexible than usually thought.

Other participants in the Committee's investigation affirmed this conclusion. McHale states as a principal conclusion that U.S. energy usage could be reduced significantly without appreciable effects on living standards or growth. Citing the examples of Germany as well as Sweden, John Sawhill in his testimony confirmed that healthy economic growth does not depend on profligate energy use. Per capita energy consumption in those countries is 45 to 55 percent lower than ours.

Ross and Williams, in their paper for the Committee, set forth three basic points: (1) that economic growth over recent decades has been dominated by activities for which efficiency in the use of energy has been a minor concern; (2) that rising energy prices now provide incentives to exploit truly enormous opportunities to save energy through technical changes; and (3) that some relatively minor changes in policies relating to energy can give us a robust economy without significant growth in aggregate energy consumption.

These authors examined potential savings in the residential, commercial, industrial, and transportation sectors. They found that, if the fuel conservation measures they considered had been in effect in 1973, fuel consumption would have been less than 60 percent of what it actually was; 18 more years of energy growth at the historical rate would have been required to reach the actual 1973 level of consumption. They contended that an aggressive conservation program could put their fuel saving measures into use, leading them to conclude:

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[32] John G. Myers, "Energy Conservation and Economic Growth—Are They Incompatible?", p. 28.

[33] The material from the RFF study was cited in "Will Energy Conservation Throttle Economic Growth?", Business Week, p. 6.

[34] M. H. Ross and R. H. Williams, "Energy and Economic Growth," p. 10.

This strongly suggests the possibility of pursuing something like zero energy growth out to the early 1990s without jeopardizing overall economic growth or, in fact, without significantly shifting the course of economic development.[35]

The Conference Board study by Myers examined what the historical data implied for the future growth of energy use. Various rates of decline in the energy-GNP ratio were evaluated, assuming that GNP would continue growing at 3.5 percent per year.[36] At a decline rate of 0.6 percent, total energy use would rise at 3.0 percent per year from 1973 to 1988, while a 1.2 percent decline rate would yield energy growth of 2.3 percent per year. If an accelerated 2.0 percent decline in the energy-GNP ratio could be achieved—and this was judged "reasonable" in light of recent energy price increases—then energy use would grow at only 1.5 percent per year from 1973 to 1985, or less than half the growth rate of the 1947 to 1973 period. The study's conclusion was that energy use through 1985 would grow at a much lower rate than prevailed in the preceding two decades. It found the link between economic growth and energy use to be "more elastic than is commonly assumed," if time is allowed for the necessary adjustments in production and consumption.

The study's finding that a 1.5 percent annual growth rate for energy consumption would be reasonable coincides with a finding by the Institute for Energy Analysis of Oak Ridge, Tennessee, that such a rate would have no adverse effects on the economy.[37] With this energy growth rate, claimed the Institute, real GNP growth of 2.5 to 3 percent still could be attained.

Harvey Brooks, Professor of Technology and Public Policy at Harvard University, confirms the general conclusion on this subject: "All the recent evidence indicates pretty clearly that there is probably a considerably more flexible relationship between energy growth and gross national product than was supposed in the past."[38]

The Longest Run—Entropy as the Ultimate Limit to Growth

The theoretical underpinning for a belief in an ultimate physical limit to growth is found in the law of entropy, which has been reemphasized in economics recently by Professor Nichols Georgescu-Roegen of the University of West Virginia. This natural law, based on the propositions of thermodynamics, states that entropy (the proportion of the earth's fixed endowment of matter—cum-energy that is "unavailable") is constantly increasing; that is to say that the earth's energy and matter are being converted constantly from usable to unusable forms by combustion, wear and tear, and rendering into waste. Just as heat always passes from the warmer to the cooler medium and never the reverse, the process of entropy cannot be reversed. Georgescu-Roegen puts the matter as follows:

Thermodynamics divides energy and matter into two qualities—available to man for his life purposes, and nonavailable. Matter or energy, while remaining continuously constant, may change its quality, but—and this is an important point—always by the degradation of available into nonavailable form.[39]

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[35] Ibid., p. 36.
[36] Myers, p. 28.
[37] Cooper and Weinberg, Institute For Energy Analysis, cited in "A Preliminary Social and Environmental Assessment of the ERDA Solar Energy Program, 1975–2020."
[38] Business Week, "Will Energy Conservation Throttle Economic Growth," p. 68.
[39] Georgescu-Roegen, p. 64.

In his paper for the Committee, Georgescu-Roegen notes that the entropic process occurs at a gradual pace in nature but is greatly accelerated by man in his quest for ever more productive technologies and higher levels of consumption. Since the amount of matter-energy from which all useful materials must be derived is finite, the speed with which this endowment is used up will determine how long economic growth and, ultimately, life itself can be sustained on earth. Ultimately, therefore, the economy of resources hinges on demand. In his words:

> It is the amount of terrestrial resources that determines the possible life span of the human species. . . . And being finite, it sets an upper bound to the "amount of life" of the human species measured in man-years. . . . The upshot is that, in the ultimate analysis, the economy of resources hinges mainly on demand.[40]

From this basis, Georgescu-Roegen insists that living generations have a moral obligation to limit (indeed, to reduce) population and entropy so as to "minimize the regrets" of some future generation that must cope with a difficult and possibly violent adjustment, as the requirement of our materials-intensive and polluting society outstrip the remaining beneficence of the planet. We have this obligation, he argues, whether the physical limits to growth are close at hand or far away. Even reversion to a steady state (i.e., zero growth) will not save mankind indefinitely in this longest of runs because even a steady state involves entropy. Curtailment of population to a level that could be fed by organic agriculture would provide the longest period of survival for our species. But man's future is finite. Georgescu-Roegen notes that the world population explosion of the present era brings this adjustment period closer and threatens to make it painful.

Georgescu-Roegen argues that an entropic view of economic processes must supplant the traditional mechanical paradigm in economics.[41] In this connection, he dismisses as "the greatest fallacy of the history of economic thought" the view that market prices can allocate resources appropriately over time. Future generations, he points out, are excluded from the bidding. For this reason, he says, "the faucets through which terrestrial matter-energy pours into the economic process and the drains by which waste returns to the environment must be put under a control independent of the market or any ownership."[42]

Sterling Brubaker, in his book, "In Command of Tomorrow," asserts that there are two paths which are "open to man in order to secure permanent occupancy." The first, like Georgescu-Roegen's, is a "low-technology course" in which we would aspire to a modest but sustainable place in the natural system by changing to technologies that are nondepleting in character. Reliance on the constant energy flow from the sun and on biological recycling of materials would be key elements. The other path is a high-technology course in which

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[40] Ibid., p. 80.

[41] Based on these arguments and the fact that the economic process, as he sees it, is an extension of the biological evolution, Georgescu-Roegen concludes that the disciplines of thermodynamics and biology are the necessary torches for illuminating the economic process. Conventional economics simply does not offer the framework for dealing with the ecological problem. The very notions of "equilibrium" in economics and ecology are antithetical. In macroeconomics, equilibrium does not refer to physical magnitudes at all but to a balance of desires between savers and investors. Under current institutions, this implies a positive flow of net investment to offset the savings, which means increasing use of materials passing through the system—a biophysical disequilibrium. It must be faced, he contends, that the nature of the ecological problem is entropic.

[42] Georgescu-Roegen, p. 65.

a calculated effort would be made to escape the constraints of resource exhaustion. A virtually inexhaustible source of energy would have to be found that would make use of more common materials. While we might face limits to the magnitude of activity sustainable at any time, according to Brubaker, we could hope to escape the time limit implied by exhaustion. He stressed that the quest for constraint-releasing technology would have to be a conscious social choice with the decision made long in advance. The search is apt to be "extended, expensive, and risky." In such a context, he feels, conventional market signals cannot be relied upon to effect fundamental change.

His belief is probably correct that Americans, if forced to choose, would prefer the second path. His admonition to behave in a way that prolongs the option for future generation to change this judgment also is sound. To accomplish this, he proposes an interim strategy the intent of which would be conservation, preservation, independence, innovation, and population restraint.

The Need for a Comprehensive Natural Resources Policy

Developing a comprehensive natural resources policy commands high priority because, at least in the long run, rising costs and scarcity of some resources will impose a burden on the economy. The need for a comprehensive policy is emphasized, because of the adverse effects of the past approach, which has been characterized by scattershot, one-resource-at-a-time measures. In the 93rd Congress, for example, more than 200 bills dealt with materials problems but most dealt with a single resource or sector of the economy. Of the eight bills which dealt in a comprehensive way with development and conservation of materials, not one was reported to the floor of either House. Donald Rice, President of the Rand Corporation and chairman of the National Commission on Supplies and Shortages, put it this way: "By continuing its ad hoc, largely uncoordinated intervention in the economy, the government is increasing the likelihood of inducing shortages or prolonging those caused by natural or political events, here and abroad." [43]

Talbot Page echoes the same theme in his recent book on natural resources.[44] He says that the consequences of having a national policy "emerge" as the result of an accretion of numerous individual decisions is that "the policy, formed after the fact, takes on some of the contradictions accumulated over separate and disparate decisions." This is the difficulty into which our present piecemeal materials policy falls.

This theme has been echoed over and over again. S. Victor Radcliffe, in an analysis of this topic entitled, "National Policies and Materials Research and Development," concluded:

> While there is a substantial current Federal investment in research and development concerning materials . . . the actual mix of activities and the overall emphasis arises from response to the policy concerns of a variety of agencies and departments rather than to the objectives of a national policy focus for materials analogous to that existing for energy.[45]

[43] Donald Rice, "Shortages and Economic Planning," p. 1.
[44] Talbot Page, p. 108.
[45] "Additional Background Studies," National Commission on Supplies and Shortages, p. 84.

What would a comprehensive natural resources program look like? A primary element of such a policy, stressed by Long and Schipper, is the establishment of economic incentives to turn our industrial structure toward less resource and energy-using technologies. This technique could be complemented by the collection and dissemination of information on appropriate technologies and by regulatory policies.

Chynoweth stressed the same theme, stating that "the Federal Government will have to provide broad but sensitive guidance of the national economy from an era of material growth to one of material conservation." [46] Economic theories and models will have to adjust to a more finite world but continued economic growth need not be incompatible with a policy of material conservation. He recognized that such a policy may not come easily: "To embark on a national course of material conservation is a massive and historic turnaround that will require the modification of many long-held views." [47]

The President's Commission on Population Growth and the American Future also emphasized in its 1972 report the need for a long-term and comprehensive national policy on natural resources. They saw a need for—

> continuous monitoring and evaluation of the long-term implications of demographic changes, of future resource demands and supplies, of possible pollution overload situations, and of the underlying trends in technology and patterns of social behavior that influence these factors.[48]

Acknowledging that parts of these tasks are being performed by isolated agencies, they recommend that responsibility for such functions be centralized in some agency that could serve as a "lobby for the future."

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[46] A. G. Chynoweth, "Materials Conservation—A Technologist's Viewpoint," p. 40.
[47] Ibid. p. 42.
[48] "Additional Background Studies," p. 85.

VI. PRODUCTIVITY AND TECHNOLOGICAL CHANGE

The progress of technology—improvements in products and the efficiency of production—constitutes the primary source of productivity growth. Other sources have been increases in education and shifts in the economy's structure toward high-productivity sectors. During most of the twentieth century, productivity growth has accounted for more than half of the increase in real gross national product. The remainder has been traceable to the rising inputs of labor, capital and natural resources. John Kendrick argues in his paper for the Committee that, since these physical inputs have not increased much faster than population, most increases in per capita real income have been due to productivity advances.

Technological progress makes it possible to generate more output per unit of inputs. Specific ways in which technology has been employed to increase productivity were outlined by Professor Renshaw in his paper for the Committee. He cited increases in scale, i.e., larger production facilities, as perhaps the most important source of increased productivity. Increasing process speed was another critical factor. He estimated that faster travel times and speedier production processes may have accounted, directly or indirectly, for between one-third and one-half of all improvements in productivity in this century. He saw improvement in energy conversion efficiency as the third most important source of increased productivity, citing an estimate by Claude Summers that the efficiency with which fuels were consumed increased by a factor of four between 1900 and 1970. Renshaw believes most of the potential from these factors has now been exploited, leaving less scope for such productivity gains in the future.

Extent of Recent Productivity Slowdown and Its Causes

The data on productivity advance during the three decades since World War II reveal a marked slowdown in recent years. Total factor productivity grew at the rate of 2.4 percent per year from 1948 to 1966 but only 1.7 percent for the 1966–1973 period. Output per man-hour grew at annual rates of 4.1, 3.0 and 2.1 percent respectively for the periods 1947 to 1953, 1953 to 1966 and 1966 to 1973. Performance since 1973 has been distorted by the deep recession of 1974–1975 and the gradual recovery from it.

Kendrick summarized the main reasons for the slowdown in productivity gains since 1966: the large influx of inexperienced young people and women into the labor force, some deceleration in the rate of economic growth, a substantial decline in the share of R&D outlays in GNP, adverse changes in attitudes, and increased government regulation of the economy.

Separate analyses by Denison and Perry have evaluated the importance of the first of these factors, i.e., the influx of inexperienced

workers.[1] Denison calculated that the accelerated growth in the number of young people and women working (both of whom receive below average compensation) caused one-third of the slowdown in average labor productivity. Perry's estimate was 28 percent. Denison attributed the remainder of the productivity slowdown to a decline in the intensity of demand relative to capacity. Perry found that 38 percent of the slowdown was attributable to poorer capacity utilization and agreed with Denison that this was the most important single explanation.

The Congressional Budget Office (CBO) has cited the sheer growth of the labor force as "the major reason for the smaller gains in productivity in recent years.[2] The CBO argues that the economy could not absorb millions of new workers and at the same time increase the output of those already on the job.

Rufus Miles finds another major source of the productivity decline in the "numerous forms of noncompliance with the rules and disciplines essential to good and competitive production".[3] He argues that these have increased over the years to "an astounding and hazardous degree." Miles' examples include organized slowdowns on production lines; "job actions", involving organized failure to report to work; wildcat strikes; boredom and carelessness in the production system; alcoholism and drug use; high absenteeism and turnover of personnel; and the widespread disappearance of pride in craftmanship. Such factors, he concludes, "have for some time been cutting into productivity and making American products more expensive and less attractive in comparison with foreign competition."[4]

Renshaw argues that the most important set of reasons for declining productivity growth is the fact that the inherent limits on the scale, speed and energy efficiency of equipment have now been approached in many processes. While this may be true of best-practice technology in some processes, much room for improvement remains. Much has been written recently, for instance, on opportunities for greater energy efficiency.

A recent analysis by Chase Econometrics concludes that a major factor in the productivity slowdown has been the reduced[5] rate of investment growth. These analysts found a high correlation between the proportion of GNP spent on fixed investment and the growth in productivity. They then pointed out that constant-dollar plant and equipment spending has risen by only 1.9 percent per year since 1966, whereas it increased by 4.6 percent per year for the period from 1949 to 1955.

John Stein and Allen Lee of the Rand Corporation supported the importance of capital formation for productivity.[6] In examining productivity growth in 10 industrial countries between 1963 and 1974, they found that the growth rates in aggregate labor produc-

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[1] Edward F. Denison, "Accounting for United States Economic Growth, 1929–1969," and George Perry, Brookings Economics Papers, 1971.
[2] Harry B. Ellis, "Is The U.S. Losing the Industrial Race?", p. 2.
[3] Rufus E. Miles Jr., "Awakening From The American Dream," p. 64.
[4] Loc. cit.
[5] Michael K. Evans, "The U.S. Economy to 1985: A Troubled Decade Ahead," p. 20.
[6] John P. Stein and Allen Lee, "Productivity Growth in Industrial Countries at the Sectoral Level, 1963–1974," p. 36.

tivity and in capital-labor ratios are highly correlated and that the U.S. was the only country in their study to experience deceleration in both variables. They found that much of the difference in growth between the U.S. and other countries was attributable to the relatively rapid growth of the U.S. labor force.

On the other hand, the recent analysis by the Bureau of Labor Statistics disputes this view of the importance of investment. The BLS states that "only a minor part of the slowdown in productivity growth can be attributed to the rate of capital formation." [7] Indeed the role of investment must be viewed in light of the documentation by Denison cited in Chapter IV on the limited role of investment in explaining growth overall.

Chase Econometrics also presented empirical evidence refuting the common belief that the shift toward service industries has hurt productivity.[8] In fact, the fastest productivity growth in the entire nonfarm private economy has occurred in transportation, communications and the utilities, which are components of the services sector. Chase found that, in constant prices, the growth of the private services and government sectors is not enough greater than the economy's overall average to explain much of the productivity slowdown. In fact, only 0.1 to 0.2 percentage points of the slowdown can be attributed to the shift among sectors.

Recent analysis by the Bureau of Labor Statistics confirms Chase's conclusion about the small role of the shift to services. BLS examined the "shift to services" in two ways. First, the narrow services sector—business and personnel services only—was separated, and the shift and productivity effects were computed for the period since 1947 as well as for subperiods of that time. The average annual effect was negative but less than 0.1 percent in all periods, rising slightly for 1966 to 1973. Then the broadest possible definition of services—all sectors except manufacturing, mining, construction and agriculture—was tested. The effect was found to be small and positive throughout the postwar period. This led the BLS analysts to conclude that "the slowdown in the rate of productivity growth finds only a minor source in the widely discussed shift to services." [9]

The slowdown in labor productivity growth from the period 1947 to 1966 to the period, 1966 to 1973, was attributed to various causes by the BLS. This breakdown is shown below. The decline attributed to intersector shifts reflects primarily the tapering off of labor transfers from agriculture and mining to other sectors and loss of the resulting productivity gain.

Slowdown in labor productivity growth: 1947–66 to 1966–73

Change:	*Percent per year*
Intersectoral shifts in labor hours	−0.3 to −0.4
Change in labor force composition	−0.2 to −0.3
Change in rate of capital formation	0.0 to −0.1
Rise in pollution abatement, worker safety, and health expenditures	−0.1 to −0.2
Total of listed effects	−0.6 to −1.0

[7] R. E. Kutscher, I. A. Mark, and J. R. Norsworthy, "The Productivity Outlook to 1985: A Summary of the BLS Productivity Projections."
[8] Evans, op. cit., p. 41.
[9] Kutscher, op. cit., abstract.

Future Productivity Changes

The critical question about productivity growth is whether the recent slowdown can be reversed. The two papers in the Committee's compendium which examined this topic come to conflicting conclusions. John Kendrick expects the increase in total factor productivity for the coming decade to be somewhat above the 1.7-percent rate of 1966–73 but to fall short of the 2.4-percent rate of the 1948 to 1966 period. He projects growth in labor productivity to equal the longer-run rate of just over 3 percent a year. Renshaw concluded, on the contrary, that the prospects for further improvements in labor productivity appear to be quite limited.

Kendrick cited two major reasons why total factor productivity may not regain its earlier postwar rate: 1) the declining quality of domestic natural resources together with programs for greater energy independence, both implying diminishing returns in extractive industries; and 2) the lower ratio of R&D expenditures to GNP, which causes a slower increase in the stock of knowledge and the rate of invention and innovation.

Kendrick is more optimistic about labor productivity. One reason for this is that the decline of labor force growth foreseen in the 1980s will permit and, indeed, induce a faster growth of the capital-labor ratio than that experienced since the early 1960s. Another reason is his belief that the basic personal values and the legal and institutional framework of the economy are more favorable than those prevailing even during the earlier postwar years of relatively strong productivity advance. Kendrick refers to "cybernetic" forces in society which tend to correct unfavorable developments, either through built-in stabilizers or through conscious policies to reverse the adverse trends once they are recognized. For example, he says, the proportion of investment devoted to pollution control, health, safety, and energy conservation will stabilize or possibly even decline with a resulting increase in the productivity of investment as conventionally defined. Also helping to boost productivity growth is the movement toward more efficient rates of capacity utilization.

Renshaw, on the other hand, is very pessimistic about productivity gains. He projects that they will gradually decline to zero and perhaps even become negative before the turn of the century. He speculates that real GNP per worker will never increase by more than about 30 percent above today's level and that most of the remaining increase will occur in the next two decades. His basic reason, as mentioned above, is the limited future potential in his estimation of certain important factors contributing to past increases in productivity: scale, speed and energy conversion efficiency of production. The evidence also suggests, according to Renshaw, that it is becoming far more difficult to invent new products and discover new productive processes that are clearly superior to those already in use. As for the most effective way to increase productivity in the short run, Renshaw prescribed adopting fiscal, monetary, price and wage measures that are likely to be the most effective in reducing unemployment.

Burkhard Strumpel, in his paper for the Committee, supports this negative assessment. He states that productivity gains in making of physical goods appear to be more difficult to achieve in the future. He emphasized that, as producers resort to the poorer and less accessible

mineral deposits, the energy, capital and labor needed to produce industrial raw materials will increase.

Carl Madden was more optimistic. He maintained that productivity gains will depend on the speed with which labor and capital can be moved from industries in which the costs of energy, resources and pollution are high relative to the value of output to industries with lower ratios. He expected such changes as shifts from virgin to recycled materials and substitution of communications technologies for transportation in moving information, images and ideas to be important.

Other recent studies of productivity tend to support the more optimistic school of thought. Roger Brinner, Director of Long-Term Studies for Data Resources, Incorporated, concluded that capital formation will be adequate to sustain the past 25 years' average annual growth rate of output per man-hour (2.6 percent) through 1990.[10] Those who believe that the manufacturing sector will attain lower productivity growth during the 1980s, he argued, must presume that nonquantifiable elements, such as work-force attitudes and gains in knowledge, have reached turning points and will contribute less to growth in the future than they have in the past.

Most projections of faster future productivity growth focus their hopes on the years after 1980. Only after this date, for instance, can the labor market be expected to tighten sufficiently to stimulate the growth of capital per worker. The share of business investment going to meet pollution control, worker safety, and health requirements also may stabilize in the 1980s. There are many uncertainties, however, which could delay the upswing in productivity growth: another recession, a lag in investment expenditures, or insufficient public and private investment in research and development.

Denison foresees two changes in conditions after 1980 that are favorable for productivity prospects and two that are unfavorable. Changes in the age-sex composition of employment will be much more favorable to productivity growth in the 1980s than at any time since 1953. Also capital per worker potentially employed should resume its increase at about the average postwar rate. Hindering productivity growth, on the other hand, will be the declining contribution of education and the end of the process of reallocating labor from agriculture to industry. Denison concludes:

> When combined, these four determinants of output are projected to be as favorable for growth of potential national income per person potentially employed from now to 1990 as they were from 1953 to 1969. This would make them more favorable than in 1969–75 . . .[11]

Chase Econometrics also concludes that productivity prospects will brighten after 1980.[12] Its reasons echo those of Kendrick and Denison: (1) new entrants into the labor force will form a smaller proportion of total employment; (2) the ratio of fixed business investment to GNP in constant dollars will increase; and (3) the trend in "nonproductive" investment for government-mandated programs will have slowed. Despite these favorable changes, Chase expects the rate of productivity gain in the U.S. over the next decade to trail those of all other major

[10] Roger E. Brinner, "Manufacturing Productivity Growth, Capital Formation and Policy: The Outlook and Options to 1990," p. 2.
[11] Edward F. Denison, "Some Factors Influencing Future Productivity Growth," summary page.
[12] Evans, op. cit., p. 3.

industrialized countries except the United Kingdom. Chase stresses the importance of achieving a faster rate of productivity growth, because only by doing so can we expect the rate of inflation to decline below 6 percent for more than brief periods of time.

In conclusion, it is likely that productivity, especially labor productivity, will grow faster over the next ten years than it has since 1966. However, it is not expected to grow so fast as during the 1946 to 1966 period. Viewing the halting performance of productivity in 1976 and 1977, Kendrick commented, "The critical question has been whether we would go back to the earlier rapid trend rate once we got past the last recession and recovery. It now appears we are still on the slower path." [13] On the same theme, Denison has stated: "Something new is apparently affecting productivity adversely, but the subject requires a lot more study before we can definitely say what it is." [14]

What Can Be Done To Increase Productivity

Kendrick made it clear, however, that a productivity growth rate below that of the earlier postwar period was not inevitable if certain steps were taken. He emphasized the following measures: (1) Adoption of tax policies and other measures to increase the proportion of GNP devoted to fixed investments; (2) a more systematic approach to public investments, both those that enhance private sector productivity and those that reduce costs of government; (3) acceleration of R&D outlays (the importance of this, he says, "cannot be overemphasized"); (4) creation of a federal agency with "primary responsibility for monitoring economic growth and progress and developing recommendations for basic policy and specific legislative and administrative measures to promote economic progress generally and productivity advance in particular." [15]

With regard to the last recommendation, a recent report by the Government Accounting Office found a positive relationship between national productivity programs and sustained productivity growth in the foreign countries that have such programs.[16] Given that the United States may face the most difficult productivity problem, that other national productivity programs have proven successful and that the one example in the U.S. of a fully developed productivity effort (in agriculture) has been so successful, it is ironic that we do not have a national program for productivity improvement.

Such a program is all the more important in light of the growing dominance of the service sector, which now holds the key to whether healthy rates of productivity growth can be sustained in the future. Professor Theodore Levitt, who has researched the productivity potential of service industries extensively, believes the potential is great and can be realized. A precondition to high efficiency and low cost in the service sector is the same sort of discipline that makes modern manufacturing so efficient, namely (a) the employment of industrial modes of thinking about the production of services and, often, (b) large amounts of capital. He cites the supermarket as a pioneering

[13] "Productivity Is a Worry Again," Business Week, p. 22.
[14] Ibid.
[15] Kendrick, p. 17.
[16] Comptroller General of the United States, "Manufacturing Technology—A Changing Challenge To Improved Productivity," p. 14.

example of how management alone can revolutionize a service industry. "Instead of looking to the service workers to improve results by greater exertion of animal energy, managers must see what kinds of organization, incentives, technology and skills could improve overall productivity." [17]

According to recent studies, the word that should be singled out for emphasis is incentives: A study for the National Science Foundation found that "of all the factors which help to create motivated/highly satisfied workers, the principal one appears to be that effective performance be recognized and rewarded." [18] Another study of over 400 plants across the United States found that, when these plants instituted work measurement, their productivity rose by an average of 15 percent.[19] When plants instituted wage incentives where previously there was work measurement, productivity rose by an added 43 percent. Thus, the average increase from no measurement to incentives was 64 percent. Though pay tied to productivity is the most powerful motivator of work performance, only 26 percent of U.S. workers are on incentive pay.

The Role of Technology

Modern technology by now has affected society in every corner of the earth. Often, however, new technologies have manifested their effects first and most extensively in the United States, because this country has pioneered some of the most revolutionary technologies: aircraft, computers, mass-produced automobiles, and electronic communications. Each of these developments has altered civilization fundamentally. For each such bold and pervasive advance there are many prosaic improvements in ways of doing things that work their effects steadily but less visibly. At least until recently, many Americans regarded technical change as an unmitigated blessing: the faster its pace and the larger its scale, the better!

Whether in small steps or sweeping changes, technological progress has accounted for a large share of the rise in living standards throughout the world. It also has had powerful effects on the structure and organization of the economy: (1) By stimulating the growth of technically progressive industries relative to others; (2) by increasing the optimal scale of many operations; and (3) by altering input proportions in many sectors.

For instance, the well-known improvements in agricultural methods, pioneered largely in this country, have led to consolidation of family farms into large-scale operations, have helped to hold food prices down, and have released labor to man the great postwar expansion of trade and services. Without this release of farm labor, postwar growth rates in most OECD countries would have been much lower. The development of industrial technologies embodying great economies of scale, moreover, has brought increasing division of labor and rising trade among regions and nations. The enormous improvements in transportation technologies have facilitated this trend by making movement of people and goods cheaper and quicker.

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[17] Theodore Levitt, "The 'Big Mac' Theory of Economic Progress," p. 138.
[18] Mitchell Fein, "Improving Productivity by Improved Productivity Sharing," p. 45.
[19] Ibid., p. 46.

It has been a common pattern in the past for new industries based on technical breakthroughs to lead the economy's growth. Then, after a rapid expansion, the new sector's growth slows as its products achieve wide distribution and as the production economies from learning and large-scale production are fully exploited. Earlier in the postwar period, biochemicals and other drugs, plastics, aircraft, synthetic fibers, light metals, television, and electronics provided a strong thrust to income and investment. Some observers believe that several vital postwar industries now have reached a mature stage. To the extent that technology stagnates, growth in output and living standards will slow.

A key question for the United States at present, and one arousing much controversy, is whether new products and industries with a potential for mass markets will continue to arise at a sufficient rate to propel rapid growth. Improvements in technology will be just as crucial in the future as in the past. Indeed, their importance will increase in the 1980s as manpower becomes scarce and less mobile.

Recent Constraints on Technology and Innovation

A certain pessimism exists in some circles about the future of technology development in the United States. Some analysts believe that the Nation has exhausted the potential of several important postwar developments and lacks the opportunities and perhaps the drive to create new ones. For instance, Renshaw asserted in his paper for the Committee, "As far as important new consumption goods are concerned we seem to be suffering from a profound technological depression." [20] He comments that permanent press pants and pocket calculators are virtually the only new consumption goods introduced in the last decade with a market potential close to 100 percent.

Professors Allvine and Tarpley, in their paper for the Committee, argued likewise that important earlier innovations were maturing by the 1970s. "Unfortunately," they said, "they were not being replaced by the new breakthrough advances necessary to generate expansionary waves of investment and employment through the economy." [21] Indeed, the President's 1976 Report on National Growth and Development stated, "With exceptions such as calculators, there are few domestic industries now undergoing rapid growth and development." [22]

Jerome Wiesner, President of the Massachusetts Institute of Technology, also has referred to the United States as a "technologically mature" society.[23] One manifestation of this technological maturity, he says, is that a larger share of the innovations go into replacement technologies, serving to sustain existing industries, rather than creating new ones that compete with today's. Thus, they precipitate less radical social and economic change than fundamentally new technologies would do. This view that the momentum of technical progress is waning brings to mind the "long wave" theories of investment behavior referred to in Chapter II, which hold that the backlog of innovation and investment needs built up during the years of depression and war has been exhausted, leaving a less buoyant economic future ahead.

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[20] Renshaw, p. 34.
[21] Allvine & Tarpley, p. 55.
[22] "The 1976 Report on National Growth and Development," p. I–8.
[23] Energy, Research and Development Administration, "Technological Innovation and Economic Development: Has the U.S. Lost the Initiative?" p. 6.

The 1974 report of the National Science Board argued that U.S. performance in fostering science and technology has declined in recent years, in that (1) less money and manpower are being invested in research and development (R&D) than in earlier years, (2) this R&D is yielding fewer inventions and contributing less effectively to U.S. productivity and competitiveness, and (3) the social environment today is less conducive to technological innovation than in the past, and may become still less so.[24]

If it is true that the contribution of technological progress to the economy has declined, one must seek to discern why this is so and whether the causes are transitory or long-run in nature. Then one must determine what should be done in response.

Wiesner adduces two reasons for the slowdown in technical progress. One is the financial plight of the universities that perform most of the basic research providing the foundation for innovation. A second is that increased government regulation of business inserts an important new and often arbitrary risk element into the investment decisions of many industries. Wiesner is convinced that, taken together, these difficulties contribute substantially to the slowing of the innovative process. He concludes:

> The United States has moved in recent years from a situation in which all our forces, commercial and public, encouraged the innovation which created our spectacular scientific and industrial capabilities to a situation in which there are ever-increasing deterrents to create change. . . .[25]

On the other hand, Jacob Rabinow of the National Bureau of Standards charged at hearings before the Committee that the marketing of new products by U.S. firms is slowing, because more and more markets are dominated by a few large firms. As innovative firms become established and as management functions pass from innovators to professional managers, decisions become more conservative. As firms become large factors in a market, they tend more often to oppose innovations in their product lines, because they have more to lose and less to gain by supplanting existing products. Rabinow asserted that the vast majority of major inventions during the past 50 years were made outside the laboratories of the large corporations. Therefore, he urged Congress to devise ways to provide easier access to risk capital for small, innovative firms and to help new firms engaged in technology development to survive the perilous early years of the innovation process.

Professor Evsey Domar also contends that the economic stimulus flowing from a discovery of new technology or new resource deposits depends heavily on the intensity of competition in the industry involved. He fears that the desire of oligopolies and monopolies to protect themselves from capital losses on existing investments by slowing the rate at which they become obsolete is "injurious to the economy." [26]

This suspicion about the disinclination of large firms to innovate receives implicit support from Schwartz and Kamien in their study of the relationship of firm size to R&D effort. They concluded,

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[24] National Science Board, "Science Indicators—1974."
[25] Energy Research and Development Administration, op. cit., p. 11.
[26] Leonard Silk, "The 'Secular Slowdown' Thesis," p. 1.

The bulk of the evidence indicates that, among firms engaged in R&D, relative effort tends to increase with size up to a point and then to decline, with middle size firms devoting the most effort relative to their size.[27]

Jacob Schmookler, who studied the innovation process extensively, found that, beyond a modest level, the efficiency of inventive activity tends to vary inversely with firm size.[28] Edwin Mansfield also found that for 29 major firms in chemicals, petroleum, and steel the number of significant inventions per dollar of R&D spending was lower in the largest firms than in the small and medium-sized firms.[29] Support for these views came from a study showing that, of 27 major postwar inventions, only seven came from large firms, and that it cost three to ten times as much to develop new products in large firms as in small ones.[30]

Science Indicators—1974 contained data showing that large firms had played a relatively larger role in innovation since 1966.[31] While firms with fewer than 1000 employees produced the greatest number of major innovations during the period, 1953 to 1966, companies with 10,000 employees or more led from 1967 to 1973. One reason for this change is that smaller firms must depend heavily on borrowed capital, and interest rates rose sharply after 1965, while access to funds for small firms became difficult. One needs to recognize also that the alleged innovative advantage of small firms may be offset in part by their inability to match the big firm's superior marketing capabilities. Thus one must give serious consideration to Rabinow's proposal to develop ways to aid small, innovative firms.

Potential Advances in Technology

Looking at the positive side, a recent survey indicated that 147 executives of America's largest corporations were generally optimistic that technology will continue its rapid advance. More than half of these executives assigned a probability greater than 60 percent to the following statement about technology in 1985:

This will truly be an "age of change" as the knowledge explosion of the 70s and 80s bears a major crop of new technology. Cable TV communications systems, rapid mass transit, cashless computerized financial transactions, and medical equipment breakthroughs will be representative of the harvest of new technological products and processes that will be operative in the society.[32]

It should be emphasized that commercialization of useful developments in science and technology depends on the state of the market. In fact, a 1974 review of over 2000 case studies of technological change concluded that:

Market factors appear to be the primary influence on innovation. From 60 to 80 percent of important innovations in a large number of fields have been in response to market demands and needs.[33]

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[27] Morton I. Kamien and Nancy L. Schwartz, "Market Structure and Innovation: A survey."
[28] Jacob Schmookler, "The Size of Firm and the Growth of Knowledge."
[29] Edwin Mansfield, "Industrial Research and Technological Innovation—An Economic Analysis."
[30] Cited in "Technology, Productivity, and Economic Growth," p. 3.
[31] National Science Board, "Science Indicators—1974."
[32] Jon G. Udell, Gene R. Laczniak, Robert F. Lusch, "The Business Environment of 1985," p. 51.
[33] Jordan D. Lewis, "National Science and Technology Policy—Its Impact on Technological Change," p. 14.

In this connection, one certainly may hope that business conditions over the next decade will be stronger and more conducive to investment and innovation than in the past eight years, when economic growth has been halting and the cost of capital very high. Indeed, there probably is a considerable backlog of investment projects accumulated during recent years of poor business that would be activated by a return of greater confidence in the future. Nathan Rosenberg, in his paper for the Committee, referred to important innovations that are being held up not because technology is stalled but because of uncertainty about the future demand. This factor serves to reemphasize the importance of sustaining the economy on a steady course.

On the other hand, the slower trend of economic growth foreseen for the late 1980s, stemming from demographic and institutional factors, will slow the pace of capacity expansion in the longer run and thus the rate of investment and innovation. In particular, the slowdown in growth in the basic materials industries may create financial strains in these capital-intensive sectors and retard the rate of innovation there.

Defining technology in its broadest sense, Joseph Coates in his paper for the Committee, states that a period of rapid technological change lies ahead. Coates foresees striking advances over the next three decades in electronics, information handling, food, and biological manipulations. Although advances in conventionally conceived physical technologies have further potential, Coates stressed the new opportunities in biological, psychological, intellectual, and social technologies which have been relatively little explored.

The concept of such "soft" technologies is unfamiliar to many people. Taken literally, the term, social technology, means "knowledge of society" and is used by Coates to refer to advances in the design of social institutions and of instruments to achieve social objectives. Coates believes that such innovations will develop naturally as the United States—with its highly educated populus and its knowledge-based economy—moves into a post-industrial era. This evolution will stimulate major shifts in the nature and location of work, in land use patterns, and in information technologies, as people, for instance, come to depend increasingly on electronic communications to perform their work and to integrate it with that of others.

Coates also points out that the nature of technical change will be affected by changing values. If tastes place less weight on material consumption and turn toward simpler ways of living for example, new types of technology need not imply more and bigger apparatus and organizations but could facilitate simpler and more personal ways of doing things.

The Role of Research and Development

From 1968 to 1974, Federal R. & D. spending in constant dollars fell by 3.1 percent per year.[34] It declined as a share of total R&D and also as a fraction of the Federal budget. Privately financed R&D rose only haltingly. Over the decade, 1964 to 1974, the total share of GNP going

[34] National Science Foundation, "Federal R&D Funding Shows Strong Recent Rise But Little Real Growth in fiscal year 1978," Highlights, p. 1.

to research and development declined from 3 percent to about 2¼ percent.

The period since 1974, however, has witnessed something of a recovery. Federal R&D spending has risen at an annual rate of 11 percent—3.4 percent in constant dollars—with energy and defense R&D leading the way.[35] The breakdown of this spending among Federal departments and agencies is shown in Table VI–1. In 1976, R&D outlays by private industry also began expanding at a faster rate. With an R&D budget of $16.4 billion in that year, the private sector financed over 40 percent of total national R&D outlays of $40 billion.[36] Because more than half of the government's $23.6 billion in R&D outlays were dispensed to private contractors, moreover, private firms actually performed about 70 percent of the total R&D activity.

TABLE VI–1.—THE DISTRIBUTION OF FEDERAL RESEARCH AND DEVELOPMENT BUDGET

[In millions of dollars]

Agency	1976 (actual)	1977 (actual)	1978 (estimated)
Total	20,759	24,465	26,317
Department of Defense	9,655	11,172	12,108
Energy Research and Development Administration	2,499	3,610	4,143
National Aeronautics and Space Administration	3,447	3,610	3,848
Department of Health, Education, and Welfare	2,546	2,959	3,009
National Science Foundation	609	686	758
Department of Agriculture	462	525	574
Department of Transportation	295	407	398
Department of Interior	314	348	361
Environmental Protection Agency	259	361	311
Department of Commerce	229	247	239
Other agencies	444	538	568

Source: National Science Foundation.

According to surveys, the resumption of growth in R & D spending is expected to continue. Battelle Memorial Institute, for example, states the R&D growth has returned to the high rates that characterized the pre-1968 period. The Institute forecast a 12.7 percent increase in 1977 in total industrial R&D activity (private expenditures plus government contracts) for a total of $30 billion. This estimate was very close to a subsequent one of $30.6 billion by McGraw-Hill.[37]

Controversy persists among economic analysts about the significance of research and development to economic growth and how its contribution comes about. A study of 16 industry groups encompassing 97 percent of all industrial R&D and accounting for more than 92 percent of all manufacturing sales, assets, and profits found a strong relationship between R&D spending as a percent of sales and the growth rates of sales, profits, and net worth.[38] The study discovered an R&D payoff that increased steadily over several years from the initiation of the effort. It also found that this "index of research intensity" correlated significantly with productivity gains. Of course, these findings may be explained in that vigorous R&D

[35] Ibid.
[36] "Survey of Corporate Research: What 600 Companies Spend," p. 63.
[37] Ibid.
[38] William Leonard, "Research and Development in Industrial Growth."

programs characterize firms and industries that find themselves for various reasons in a rapid stage of growth and productivity advances, e.g. young industries exploiting technological breakthroughs. R&D, while vital to these firms, might not yield the same prosperity in other industries in different stages of development.

Nathan Rosenberg, in his paper, contends that the pattern of R&D outlays by industry bears no simple relationship to the pattern of technological change and productivity growth. For example, the electric power sector has long enjoyed one of the highest rates of technological progress and productivity growth but has had virtually no R&D expenditures of its own. Moreover, some R&D efforts involve longer gestation periods than others, and many in the end come to nought.

The fact that innovation often requires no R&D also has been noted by Holloman, who found that very few firms actually engage in research; they develop their new products instead as part of the engineering design process.[39]

Lester Thurow even has argued in a recent paper that more R&D may not lead to quicker technical progress. In his words:

> While it may seem almost axiomatic that more research and development activities should lead to more technical progress, it is difficult to postulate this axiom on the basis of American history since 1940. More research expenditures do not seem to lead to more technical progress. The question remains, why not? The answer is unknown.[40]

Thurow postulates two possible explanations. The first is that the rise in research expenditures since 1940 has been concentrated heavily on defense and space applications, from which only limited civilian "spin-off" has been found. The high concentration of R&D spending in defense and space projects contrasts with the practice of other industrial countries, where civilian R&D almost always takes more than half of the government R&D budget. The other explanation is that scientific progress may have become more expensive "per unit of progress." For one thing, the efficiency of scientific and engineering endeavor may not have increased as much as the real cost of this endeavor. In short, we must spend more in real terms for the same rate of progress as in the past.

William Leonard also has argued that the bulk of Federal R&D spending that has gone for defense and space applications pays smaller dividends for economic growth than civilian R&D. In his study, "Research and Development in Industrial Growth," Leonard stated:

> The results confirm the thesis that the existing concentration of federal R&D spending in two industries is unproductive of growth, either because of diminishing returns to R&D encountered in these industries, or returns to R&D encountered in these industries, or the failure of firms in these industries to realize the commercial potential of innovations arrived at in federally funded R&D programs, waste of resources, or a combination of these factors. The findings support Richard Nelson's hypothesis that the opportunity cost of federal R&D contracts in defense-space programs has been slower growth, reduced productivity, and lower quality of output in the civilian sector.[41]

Though the relationship between R&D and productivity is quite complex, most observers still believe that R&D and economic growth

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[39] J. H. Hollomon, "Alternative Policies and Programs."
[40] Lester C. Thurow, "Research, Technical Progress, and Economic Growth," p. 8.
[41] William N. Leonard, op. cit.

are positively related. Morton and Kamien declared, "All the evidence—at the level of the firm, industry and economy—indicates that the contribution of R&D to economic growth and productivity is positive . . . and high." [42] Many believe that the recent slowdown in R&D effort is having an adverse effect on productivity and growth and will have a more serious one in the future. Harvard economist, Zvi Griliches, has warned, "The slack growth of the past seven years in research and development spending is coming home to roost." [43]

Government's Role in Fostering Technological Progress

In addition to the overall amount of government R&D support, there arises the question of how government should attempt to foster the process of technical progress. Currently about 27 percent of Federal spending on civilian R&D is devoted to basic research, 42 percent to applied research, and 31 percent to technology development.[44] Most civilian technology development takes place in the private sector. As the defense and space programs are exclusively government's domain, defense and space R&D is weighted much more heavily toward development.

Despite much debate in recent years about the role of government-sponsored civilian R&D, no adequately documented rationale for government-funded development of commercial technology has existed, and such endeavors therefore have been limited mainly to special areas such as nuclear power and to ad hoc projects like the ill-fated supersonic transport. Commercial technology can be patented, and its development presumably will be undertaken by private firms if the potential returns warrant. It was estimated recently that the private sector earns an average annual rate of return of 30 percent on its R&D spending, roughly twice the return from other investments.[45]

Rosenberg in his paper stresses that the implementation phase of the innovation process should be guided by the market's signals. "In general," he says, "it (government) can contribute more by providing a suitable environment for the operation of market incentives than by specific measures to aid particular industries or interest groups." Nelson and Eads also have argued that government subsidies to specific, commercially oriented technical ventures in industry are unlikely to improve the technological competitiveness of American industry.[46] Former National Bureau of Standards Director, Lewis Branscomb, reinforced this view: "My basic point is that the innovative process is driven by the market place, and the best the government can do is to minimize the barriers that impede the technology delivery system." [47] Robert Gilpin, in a recent paper for the Committee, argued that not even the large scale of many modern technology development projects provides an adequate justification for government funding.[48] A recent study by Arthur D. Little concluded that Federally funded

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[42] Kamien and Schwartz, op. cit., p. 79.
[43] Nicholas Valery, "The Declining Power of American Technology," p. 73.
[44] Jack W. Pearson, "New Ways To Bring Technology to the Marketplace," p. 28.
[45] Valery, op. cit., p. 73.
[46] Committee on Science and Technology, op. cit., p. 272.
[47] Ibid., p. 197.
[48] Robert Gilpin, "Technology, Economic Growth and International Competitiveness."

civilian R&D is not sufficient to effect substantial technological changes in the private sector, drawing attention to the fact that any broad government effort in this field would imply a major increase in spending.[49] Jordan Lewis, Director of the Experimental Technology Incentives Program of the National Bureau of Standards, commented, "These observations tempt us to conclude that, outside of basic research, we have no clear market-economic criteria for Federal funding of civilian R&D." [50]

Recently, however, a study of 17 industrial innovations by Edwin Mansfield and others discovered great variability in rates of return and a wide divergence between the private and the social returns. The median return to industry was about 25 percent per year, while a "conservative lower bound" for the return to society was estimated to be 56 percent. Most important, however, was a third major finding:

> In about 10 percent of the cases, the private rate of return was so low that no firm with the advantage of hindsight would have invested in the innovation, but the social rate of return from the innovation was so high that, from society's point of view, the investment was well worthwhile." [51]

Because of the high returns to society from innovation, these new findings, if confirmed, could provide the documentation needed to justify larger public assistance to technology development. However, one must find means to overcome the fact that prospects of public funding tend to delay or suppress privately financed efforts. If this is not overcome, then public funding may not accelerate progress, and in the end public money may only substitute for private funding without raising the total. Moreover, one must devise a fair but effective means to transfer publically funded technology to the private domain for the production phase.

Consensus has existed, however, on the important role of public funding for basic research, because no patents are granted giving proprietary rights to basic knowledge. Rosenberg stated in his paper, "I believe that the case for continued Federal support of basic research, as opposed to the commercial development of new technologies, is overwhelmingly strong and should constitute a top priority." Long and Schipper saw basic research as vital to the slow, creative process of invention and effective in speeding up the incubation process between invention and the commercial development decision. Emphasis on basic research was the only point of unanimous agreement among witnesses at the hearings on Federal R&D expenditures before the House Committee on Science and Technology.[52] Together with the fact that much research personnel may remain underemployed in the next decade, this argument makes a case for careful consideration of significant increases in Federal funding for basic and applied research.

As pointed out earlier in this chapter, important innovations are being held up by uncertainties over the state of future demand. Rosenberg recommends measures to reduce this uncertainty for certain classes of products as a means to induce technological improvements of a de-

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[49] Cited in Jordan D. Lewis, "National Science and Technology Policy—Its Impact on Technological Change."
[50] Ibid.
[51] Edwin Mansfield, John Rapoport, Anthony Romeo, Samuel Wagner and George Beardsley, "Social and Private Rates of Return from Industrial Innovations," p. 235.
[52] Committee on Science and Technology, hearings.

sired kind. Such measures could take the form of guarantees assuring certain markets for technologies which meet certain criteria. Such devices have been actively discussed for the development of certain new, energy technologies. Though he acknowledged that the potential for waste and misallocation in such arrangements is great, Rosenberg believes that the social payoff may also be very high, if the right combination of incentives and assurances can be continued over the needed time horizons.

Rosenberg also proposes that government technology policy be used to develop a capability for shifting to alternative sources of materials in various areas. To achieve such flexibility would require, he feels, some minimum, research activity at the engineering level and possibly in specific cases. He concluded, "in a world of heightened political uncertainties it would seem to be doubly important that we, as a matter of national policy, develop a capacity to reach specific goals via a diversity of routes."

In seeking to formulate improved technology policies, George Eads urges that we also step back and assess the influence of the wide range of existing policies in related fields:

> . . . a prerequisite to the intelligent formulation of science and technology policy by the U.S. Government is a clearer understanding than currently exists of the net impact of the mass of regulatory tax, patent, anti-trust, procurement and trade policies (just to name the most obvious) on private incentives to invest in technological change.[53]

[53] George Eads, "U.S. Goevrnment Support for Civilian Technology: Economic Theory Versus Political Practice."

VII. INTERACTION OF U.S. ECONOMIC GROWTH AND THE GROWTH OF OTHER COUNTRIES

From 1950 to 1972 world trade grew nearly 50 percent faster than world production, a trend unparalleled since reliable statistics were first compiled in the 19th century. Virtually every country's dependence on the outside world grew. The growth of economic interpendence is also reflected in other aspects of economic life such as tourism, use of foreign workers, the transfer of technology, and investment across national boundaries. For example, United States direct investment abroad rose from 4.1 percent of the GNP in 1950 to 8.2 percent in 1971.

The fact that the world economy is becoming increasingly interdependent means that account must be taken of the international as well as the domestic impacts of measures that affect growth rates or patterns. As Irma Adelman of the University of Maryland put it in her paper for the Committee, "Since changes in U.S. trade can thus have an enormous impact on the economies of most other nations, the United States has strong moral responsibility to consider seriously the worldwide impact of its growth and trade policies." [1]

The rate of growth of the U.S. economy affects the economy of every other country in the world to varying degrees. Similarly, the U.S. economy is affected to varying degrees by the performance of other countries. This has been especially clear recently, as the trade imbalances of the United States, Japan, and Germany have grown beyond all previous bounds and the United States has urged other industrial nations to emulate its expansionary policies for the sake of the balance and growth of the world economy. The share of imports plus exports in U.S. gross domestic product rose from about 9 percent in 1951 to 11 percent in 1970 and to 15 percent in 1974. Thus, growth policy is one of the most important areas where the concerns of all countries, both developed and developing, overlap.

Impact of U.S. Economic Growth on the Economies of Other Countries

Adelman suggests that the U.S. rate of economic growth affects the growth rates of other countries in two distinctly different ways: (1) a high rate of U.S. growth enhances U.S. demand for imports generally, and (2) a high rate of U.S. growth specifically increases the U.S. demand for external oil, which ultimately depresses the growth prospects for all countries not part of OPEC by generating pressures for higher oil prices, international oil rationing, or both. The overall impact of U.S. growth on the world economy depends on the net balance between these two forces.

[1] Adelman, p. 4.

Analyzing the effects of U.S. economic growth on developing nations, Adelman maintains that faster U.S. growth probably would act adversely on the trade balances of all non-OPEC trading partners but that it would benefit the developing countries in terms of overall economic progress. Under the current structure of U.S. trade and trade barriers, she says, the oil price effect would dominate the balance-of-trade impact. These balance-of-trade effects would not be outweighed by the increase in aid to developing nations in times of prosperity.

The balance-of-payments, however, is less important to developing countries than the benefits afforded to them by a prosperous world market which, in addition to increasing aid, allows them more latitude to expand their export industries and, generally, the modern sectors of their economies. This is what really counts in their development, providing faster long-term income growth, greater equity in income distribution, and increased ability to exploit economies of scale in producing export goods.

Adelman notes that:

> Arguments are being voiced by policymakers in developing countries and by liberals in the United States that we should curb the U.S. rate of economic growth in the interest of international equity . . . These arguments are entirely misguided . . . On balance, it would appear that a higher rate of growth of U.S. gross domestic product (GDP) would contribute to the growth of LDCs (less developed countries) by providing export markets and a world economic climate more conducive to international development and economic restructuring.[2]

This standard argument has been challenged in recent years by a number of developing nations, which are calling for the establishment of a new international economic order. Their basic argument is that the advanced nations have exhausted their supplies of many of the most important natural resources needed for an industrialized society and are entering into increased competition for the remaining supplies in the Third World countries. The argument concludes that continually increasing consumption by the industrial nations, which shortens supplies and raises prices, is now shutting off growth possibilities for the developing countries. In short, they argue that the industrial nations hold all of the cards in the present international division of labor, and that it is now impossible for many Third World countries to begin to catch up with the industrial world unless a dramatic transformation of the international economy takes place. For this reason, Dennis Pirages, in his paper for the Committee, maintains that during the next few decades a resource-related North-South confrontation over growth and the terms of trade can be expected.

The Committee asked the authors specifically to address the question of how a slowdown in the rate of U.S. economic growth would affect other countries. Adelman stressed that such a reduction would lead to a disastrous slowdown in the non-OPEC developing nations and would lead to further impoverishment of the poorest 40 to 60 percent of the developing nations' population. The argument supporting these strong statements is as follows:

> When U.S. growth slows, one of the most significant effects is the associated general decline of international trade. This slowdown shrinks international markets for the products of developing nations and puts considerable pressures

[2] Ibid., pp. 1–7.

on these countries to reduce their imports. The result would be that the developing nations would be forced to adopt, as rapidly as possible, and import-substitution policy which, except in foodstuffs, hurts both growth and distribution. Thus, Professor Adelman concludes, if U.S. policy is to encourage economic growth with equity in the developing nations, the U.S. should not participate in economic policies that are likely to force the developing nations to import substitution.

One of the most helpful approaches to developing country growth with equity, based on evidence from a number of studies, is to promote labor-intensive exports. But it is precisely this type of development strategy, however, that would be precluded by the shrinkage of world incomes and the decline in import demand and aid that would result from a less rapid growth rate in the industrial countries.[3]

Although many developing nations hope to find greater markets in the United States in the future, Pirages shows that only a few now rely very heavily on this country.[4] For example, sixteen countries derive more than one-third of their export earnings from markets in the United States. Canada, Japan, Mexico, and Korea are diversified traders that are heavily dependent and would be affected by slower growth in U.S. imports of consumer manufactures. Among the 12 "specialized" countries that gain most of their export revenue from only one or two commodity exports are seven which deal mainly in agricultural exports: the so-called "banana republics." Honduras, Panama, Costa Rica, and Ecuador, as well as Nicaragua. the Dominican Republic and the Philippines. These seven countries would be much less affected by changes in growth policy than they would be by decisions on tariffs or quotas on agricultural products. The remaining five countries—Venezuela, Trinidad, Haiti, Jamaica and Peru—export primarily fuels and non-fuel minerals and probably would be the most adversely affected by slower growth in the United States.

Nonetheless, there are sound reasons for believing that there is a significant positive correlation between industrial nations' and developing countries' growth. This was confirmed by a 1975 study by a group of French economists.[5] Using actual 1970–74 results and a simulation for the balance of the period, the average rate of growth of 4.5 percent for the OECD countries over the 1970–80 decade would yield a ten-year average growth rate for the non-OPEC developing countries of 5.9 percent. If the average growth rate of the OECD nations were to be lowered to 3.9 percent for the decade, the developing countries' average growth rate would fall to 3.7 percent, a significantly larger drop.

Adelman felt that the impact of slower economic growth in the United States on the growth of industrialized nations is less clear. While the effects on the markets for their products are similar to those for developing nations, they will be less severe because of the much stronger internal markets in the developed countries. This is particularly true if one considers that they as a group have a large joint market, since they (except for Japan and Canada) trade much more with each other than with the United States.

The impact of a high growth strategy on other developed countries is clearer. If the United States adopts such a strategy, the market for

[3] Ibid., p. 10.
[4] Pirages, p. 35.
[5] "The International Trade Crisis: Possible Futures for the World Economy in the Period. 1975–80," Groupe d'Etudes Prospectives Centre Francais du Commerce Exterieur, Paris, 1975.

oil in the 1980s is likely to be characterized by upward pressure on prices, recurrent shortage of crude, balance-of-payments crises and, consequently, lower average growth rates in Europe. However, the impact of balance-of-payments difficulties would be less serious for the industrialized nations than for the developing countries since the former have greater potential for adaptation through changes in the structure of production. This led Adelman to conclude that "the differences between the impact on developed countries and on the LDCs are thus more a matter of scale than of quality."

Impact of Other Countries' Economic Growth on the U.S. Economy

Both Adelman and Pirages agreed that, with the exception of the oil price hike and similar events, the economic actions of other nations have a relatively small effect on the U.S. rate of economic growth. This is because imports and exports combined, while large in dollar volume, constitute only about 11 percent of the U.S. gross domestic product. The driving forces in the U.S. economy are predominantly internal. Professor Adelman, however, indicated that U.S. dependence on foreign trade has increased greatly in the past 20 years and that it probably will continue to do so.

At present the United States is in a comparatively strong position, being the most nearly self-sufficient of the industrial countries in the critical non-fuel minerals. Thus, excluding petroleum, it is not particularly vulnerable either to price increases or embargoes. The United States is a heavy importer of such minerals as nickel, cobalt, manganese, tin and bauxite, but U.S. stockpiles are adequate for more than two years normal consumption. As Pirages put it, "non-fuel mineral dependence is mitigated by a significant emergency stockpile, an ability to absorb higher prices since each mineral makes up only a small portion of U.S. trade, and the possibility of developing mineral substitutes." [6] An increase in price or an embargo on any non-fuel mineral (an unlikely event) would be more a nuisance than a long-term threat to the U.S. economy. Pirages stated his conclusion as follows:

> Short of formation of a "macro-cartel" covering a large number of non-fuel minerals among exporters, an event which is not even remotely possible within the next decade, there is little that non-fuel mineral exporters can do to adversely affect United States growth.[7]

Other industrial countries, particularly Japan and those in Europe, are much more dependent on imported foods, fuels and minerals than is the United States. Therefore, the fortunes of these countries would be affected by future price increases or embargoes to a much greater extent than those of the United States. However, the major share of trade in primary commodities, aside from oil, takes place among industrial countries (including the Soviet Union and Eastern Europe). These countries, according to Pirages, import more primary commodities by value from each other than they do from developing countries. This is true for each of the non-oil commodity categories—foodstuffs, ores, metals, and other raw materials. In the aggregate, only 30 percent

[6] Pirages, p. 31.
[7] Ibid., p. 32.

of the exports of non-fuel primary commodities originate in the developing countries compared to 70 percent in the industrial countries. Therefore, the potential of any cartel composed of developing countries is limited.

Actually, the greatest international influence on the long-run future of the economy is likely to come from other industrial countries rather than from the developing nations. The United States is likely to encounter increasing competition from other industrial nations for markets here and abroad. As Adelman sees it, U.S. industry is burdened by heavy investment in obsolescent technology and confronted with relatively high labor costs. The technological dynamism of the Northern European and Japanese economies has increased both absolutely and relative to U.S. industry, especially in the traditionally capital-intensive sectors of the economy. Adelman contends that "there is no reason to believe that these trends will not continue over the next decade or so, in the absence of strong policy initiatives to counteract the slowdown in U.S. industrial modernization." [8] It might be added that several Third World countries, such as Korea, Brazil, and India, are now competing effectively in world markets for manufactures.

Increased competition should not be met by protectionism. Rather, the long-run interest of the United States is best served by allowing the effects of competition to be felt and by encouraging domestic industries to respond by increasing R&D, by technological innovation, and by shifting the structure of production towards goods in which we have an inherent or potential competitive advantage. Thus, Adelman believes that the stimulus of foreign competition could be positive, forcing adjustments toward more efficient industry that will be able to hold down prices and raise the U.S. standard of living.

Energy and the International Economy

Perhaps the area of most complete agreement between Adelman and Pirages was on the critical role that energy will continue to have in international economic relations. As Pirages stated, "Energy policy will be the crucial aspect of future United States growth policy." [9] He stated that, during the next decade, retaining access to secure sources of petroleum and natural gas remains the chief dependency problem for the United States and concluded:

> If the pressures of intensive export competition with other industrial countries are to be avoided, future growth by either rapid development of capital-intensive alternative energy sources . . . or a massive energy conservation campaign coupled with carefully directed economic growth designed to minimize energy consumption, or a combination of all of the above will be required.[10]

Adelman not only stressed the importance of energy but also arrived at a very similar prescription. One of her main concerns pertained to the effect on the market for oil in the 1980s if the U.S. adopts a high growth strategy. She therefore recommends that, as part of the adoption of a high growth strategy, the United States intensify its efforts at oil conservation and substitution. Her conclusion is a succinct

[8] Adelman, p. 9.
[9] Pirages, p. 25.
[10] Ibid., p. 26.

statement of what needs to be done regarding the relationship between energy and the future of international economic and political relations.

Without a successful effort to ease U.S. pressures on the world's oil supplies, serious tensions will arise within the Western alliance and between the United States and the LDCs which will greatly inhibit U.S. international policy. The Government must face up to the fact that economic interdependence generated by competition for oil imports will seriously constrain its economic options in the future and strongly affect the national and international political climate. Over the next decade, the only way to decouple, to some extent, our economic policy from that of other nations is to engage in a much more vigorous program of energy conservation and oil substitution from domestic sources (such as coal.[11]

[11] Adelman, p. 24.

VIII. THE DECADE AHEAD

This chapter reviews a number of quantitative forecasts as well as qualitative recommendations pertaining to economic growth over the next ten years. The first section reviews the major long-term forecasts of growth rates and other major economic variables and summarizes the general assessments of economic prospects by some participants in the Committee's investigation. The second section sets forth a broad description of what a greater emphasis on the quality of growth would entail. The final section discusses the need for a national growth policy, if we are to obtain better control of the direction and quality of growth.

General Forecasts

Gary Fromm was asked by the Committee to review the most recent long-run projections. His paper covers 21 forecasts felt to be the best and most widely used U.S. economic projections for the next decade. Of the 21 forecasts, five placed primary reliance on econometric models, six used such models as an important input, while the remaining forecasts relied most heavily on reduced form and judgment methods.

The major conclusion which emerges from the forecasts is that real GNP can grow rapidly for the next several years, but that this growth rate will become increasingly difficult to sustain throughout the 1980.[1] The median prediction for annual real GNP growth for 1975 to 1980 is 4.9 percent, compared to 2.1 percent for 1970 to 1975. This rate is expected to fall to 3.5 percent, however, for the 1980-to-1985 period. Inflation rates for these two periods are projected to be 5.7 percent and 4.8 percent respectively, while the unemployment rates are 6.5 percent and 5.0 percent.

The primary medium-term (ten-year) projections done in the Federal Government come from the Bureau of Economic Analysis. Its most recent conclusion was that the U.S. economy over this period will experience slower rates of growth in real GNP and productivity than in the full employment period 1964 to 1969. Factors cited as instrumental in this slowdown were the decline labor force growth due to the age composition of population; pollution abatement expenditures by industry, which can lower productivity growth; and some shift in the industrial mix of GNP toward industries with lower levels of labor productivity. Also predicted were relatively high inflation rates, reflecting both the increase in unit labor costs associated with lower productivity growth and the high wage increases resulting from attempts to catch up with past price increases.

[1] The underlying assumptions for the models were quite similar. Most forecasters assumed only modest increases in federal spending and no real tax reduction. Monetary policy is assumed to remain moderately tight. Where assumed exogenously, inflation and unemployment are predicted to fall from present rates and be near or below historical averages of the past decade during the first half of the 1980s.

A review of recent long-term projections by the "big three"—Chase Econometrics, Data Resources Incorporated (DRI), and Wharton Econometric Forecasting Associates, Incorporated (WEFA)—supports the conclusion that growth will be somewhat slower in the future. Chase, in its forecast of March 1977, projected an average annual increase in real GNP of 3.4 percent for the next ten years.[2] This was down from their 3.7-percent projection in December 1976. The decline was primarily due to a more pessimistic long-term view of fixed business investment, which, they believe, not only serves as the main force behind output growth but also determines the rate of increase in productivity and hence real per-capita income.

DRI also came up with a forecast of 3.4-percent annual growth for potential real GNP for the period, 1973 to 1980.[3] This represents a significant slowdown in the growth of potential GNP from the late 1960s, when it was 4.0 percent. The most significant factor accounting for the slowdown in their judgment is the lower growth rate of the capital stock.

In the summer of 1976, WEFA reported that even in the most optimistic scenarios, the long-run rate of growth remains less than 3 percent for real GNP.[4] The problem, they stated, was "one of inputs:" labor force growth projected at only 1.6 percent annually over the next five years, dropping to 1.4 percent for the ten-year span; productivity growth in manufacturing remaining at the low annual rate of 2 percent for the entire period; and a drop in the rate of growth of real investment from 5 percent in the next three to four years to around 4 percent by 1985. They concluded that "all these factors, singly or in combination, continue to point toward a future with lower growth and higher inflation than that of the last two decades."

It must be recognized that econometric models—even when designed for long-term forecasting—cannot make full allowance for potential structural changes which, as seen throughout this report, will be numerous and increasingly important as time passes. As O'Toole has pointed out, the models do not adequately take account of potential new technologies, new public policies, and evolving social values.[5] He complains also that they leave out important considerations, such as indirect and long-term consequences of growth for the state of environment and for job satisfaction. He fears that the models often lead to overly simple and erroneous policy conclusions. Of course, the models are continuously being refined and can provide useful benchmark projections against which to measure the effects of parameter changes.

Most of the papers prepared for the Committee that specifically discussed growth prospects over the next decade were decidedly more optimistic than other forecasters. Herman Kahn's optimism stemmed from his feeling that the forces making for growth are so strong at present and have such great momentum that they will almost certainly triumph in the short run. He projects that "with reasonably good luck and reasonably good management," the United States should be able to achieve an average growth rate of 4.8 percent per year from 1976 to 1986. His optimism concerning growth prospects over the

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[2] Michael K. Evans, "Long-Term Macroeconomic Forecast," March 1977, p. 1.
[3] Otto Eckstein, Robert Brinner, Virginia Rogers, Robert Gough, and Allen Sinai, "Economic Issues and Parameters of the Next 4 Years," p. 2.
[4] Wharton Econometric Forecasting Associates, Inc., "A Summary of the Pre-Meeting Scenario Projections," July 20, 1976, p. 3.
[5] James O'Toole, "Work, Learning and the American Future," pp. 211–212.

next decade, however, yields to pessimism for the period beyond 1985. From 1985 to the year 2000, he foresees a growth rate falling to less than 3 percent. The social and cultural factors responsible for this decline were discussed in Chapter II. Kahn acknowledged in his testimony that the continued growth of the United States during the next decade will be constrained more by its capacity for institutional and technological innovations than by any potential resource shortages.

Carl Madden was perhaps more optimistic. He stated that there are more reasons than ever to think that, after a transition period (the length of which he did not specify), economic growth will accelerate. This is based on his judgment that economic growth depends mainly on the advance of knowledge, which is the only input to economic processes that does not itself result in substantial dissipation of energy and materials.

Richard Ruggles examined in considerable detail the relationship between economic growth and inflation. "There is no evidence," he concluded, "that recovery or economic growth has led to inflationary price increases." On the contrary, the low rates of productivity gain in recession have resulted in cost-push price increases, and the higher productivity during recoveries has resulted in greater price stability. Instead of the wage-price spiral's being aggravated by economic growth, therefore, past experience leads one to conclude that a high rate of growth and the accompanying high rate of productivity increase, which dampens the increase in wage cost, may be a necessary condition for long-run price stability.

The projections concerning long-run employment opportunities were at opposite poles. James O'Toole, at the optimistic pole, suggested that over the next 25 years the United States may achieve a situation of no unemployment other than that of a frictional nature. He also projected that, although the quality of working life will deteriorate through the early 1980s, it should start to improve by 1985 as the result of (a) changes in demographics and (b) changes in the design of jobs to give workers more authority, challenge and satisfaction.

Strumpel, on the other hand, warned that acceptable rates of unemployment can no longer be expected to result from economic policies oriented toward industrial expansion. He believes that it is impossible to achieve growth rates which will reduce unemployment to acceptable levels. Strategies focused on specific areas of the labor market are required. He concluded that "there is little chance for absorbing most of the now idle labor in our economy unless we shift our tastes from buying more goods toward buying more services, more exactly, toward consuming final products that incorporate more labor and less materials." [5a]

Emphasis on Qualitative Rather Than Quantitative Growth

The distinction between emphasizing qualitative as opposed to quantitative growth was forthrightly sounded by Congressman Joseph Fisher, an economist, who testified at the hearings:

> I think the main problem is to achieve a smooth shift in the composition of economic growth. To simplify it, away from quantity, and in the direction of quality, right across the board.

[5a] F. N. Strumpel, p. 45.

A 1975 Harris Poll indicates that this is what most of the American public also desires. By a three-to-one majority they endorsed the statement, "The trouble with most leaders is that they don't understand people want better quality of almost everything they have rather than more quantity."

Although every person probably would have his or her own list of measures to improve the quality of growth, there would be widespread agreement that it would involve changing our wasteful style of consumption. Walt Rostow has said that "the transition from the stage of high mass consumption to the search for quality is one of the three massive problems the U.S. faces." [6] He contends that our performance in the future will be judged on how well we deal with these problems, not on whether GNP increases regularly at 4 percent or 5 percent per annum. This idea is well expressed in the increasingly accepted concept, noted by Carl Madden, that growth in the future will mean "learning how to get more from less and then having the will to do it." This will be especially true if, as many believe, the next two decades will be a period in which Americans will be forced to learn to live with new scarcities and to acquire habits of personal and social thrift.

Carl Madden also stressed the need to shift the structure of production along these lines to slow down the rise of entropy. The issue as he sees it is not to stop economic growth but to offset more effectively the rise of entropy. This means producing fewer goods which cause heavy waste of material resources and pollution. He acknowledges that this is a newly perceived task, one which challenges the prevailing values of our industrial and business society.

Peter House, in a recently published book, stated that the only real assurance of developing a conservation ethic is to reprogram the society's ethics to replace areas of "consumerism" with "conservation." [7] The conservation ethic should be one that results in using the minimum amount of resources deemed necessary to carry out an activity or produce a product that does not result in undersirable side effects. This would be a revolutionary change, for the United States has never been a conserving nation, and our institutions and productive capabilities are not presently designed with conservation in mind. House therefore argues that "the further the Nation goes toward a conservation ethic, the more it will require planning and full evaluation of a powerful institutional change with its widespread repercussions."

At least from their verbal expressions, however, the American public seems ready for the conservation ethic. When a Harris Poll posed the alternative between "changing our lifestyle" in order to consume fewer physical goods, and "enduring the risks of continuing inflation and unemployment due to raw material shortages," a majority of 77 to 8 percent opted for a change in lifestyle.[8] This was despite the fact that most felt that cutting back on the amount we consume and waste will mean lowering the U.S. standard of living. These types of changes and others promoted McHale to conclude:

> Overall, the kinds of social and value changes ongoing within U.S. society, accompanied by various technological and resource-use shifts, suggest not only that growth directions will change but that growth requirements in the next

[6] Walt W. Rostow, "Economic Growth: Past and Future," p. 44.
[7] Peter House and Edward R. Williams, "Metamorphosis: The Emergence of the Frugal Society," (Draft), p. VI–34.
[8] Ervin Lazzlo, "Goals for Mankind," p. 39.

decade and beyond could be satisfied with less per capita resource use, lower environmental impacts and expanded productivity.[9]

Preston Cloud and Emile Benoit, in their papers for the Committee, presented detailed discussions of what they thought an emphasis on a higher quality of growth should entail. Cloud stated that "the only kind of growth that is both beneficial and capable of being sustained by national and world resources is growth in enhancement of the human conditions—EHC." He argues that "EHC" could be achieved through the following means: emphasizing nonmaterial ways of achieving a sense of personal value and standing in the community, eliminating planning obsolescence and emphasizing the quality and value of working material stock rather than the rate of fiscal turnover as a measure of economic well-being, deemphasizing the use of nonessential material consumption and waste as prestige symbols, and decentralizing industry and population.

Cloud maintains that the complaint that such "impractical, fuzzy goals" are not subject to numerical analysis does not hold up because numbers could be applied to EHC that are "more deeply meaningful" than those computed for GNP. The index he suggests could be derived by aggregating such factors as the value of operating capital stock, the area of protected public lands, the number of advanced degrees and other "goods," minus measurements of "bads" such as poverty, population growth beyond replacement levels, unrecycled waste, and other measurements of pollution. The behavior of this index would sum up how well or how poorly society's affairs are being managed. Cloud suggested, incidentally, that sabbatical leaves for workers are an illustration of a measure to enhance the human condition through their value to those on leave as well as through reducing unemployment.

Benoit stated that the existing "exponential growth syndrome" calls for major policy changes which would help to bring about what he terms an economy in a "dynamic equilibrium." This far more complex objective is required since we can neither continue with unrestricted growth nor simply stop growth. Our goal must be to seek "improved average levels of welfare plus the preservation of the environment on which the welfare of our descendants will depend."

"Dynamic equilibrium" aims to achieve a better quality of growth through three major policy changes. The first Benoit terms "conservation/simplification," the goal of which is reduced consumption of nonessential goods requiring nonreplenishable resources or producing pollution. This could be accomplished by "drastically reducing waste and status-display consumption, and deriving more satisfaction from services, leisure, recreational activities, and display of nonmaterial status symbols." The second major component of Benoit's plan is "scientific technological renaissance" in which (1) R&D priorities would be switched from military, space and trivial consumeristic goals over to pollution control, conservation, finding substitutes for scarce resources, and using them more efficiently; and (2) there would be a dramatic increase in government support of higher education and R&D. He claims that R&D are "indisputably the most profitable form of investment for society, in the long run."

[9] McHale, p. 4.

Benoit's most controversial and what he termed "essential" proposal is negative population growth. The goal in this case would be a marked drop in the birth rate to a level yielding an average of less than two children per family. Two separate requirements would have to be fulfilled: (1) effective, convenient, and inexpensive contraceptives for all, and (2) adequate motivation for their use. He felt that to change the motivation structure, it would be necessary to offer all families with only one or two children substantial monthly cash benefits plus retirement supplements.

These plans of Cloud and Benoit provide an idea of what a comprehensive move toward higher quality growth might look like. Though many people would not agree with these specific policy changes, they illustrate that if we are to achieve a higher quality of growth, a multifaceted approach is mandatory.

The idea of movement toward higher quality growth received support in the Edison Electric Institute's study of future economic growth.[10] Specifically, the report concluded that "a new concept of growth" is called for. Though the terms "clean growth," "quality growth" or "optimal growth" might be used to describe it, it was felt that none of these terms really captures the sense of continuous change and the multiplicity of forces involved. These include new weight being given to diversity, collective capacity, and the overall wealth of society; a merging of economic and ecological concepts; the idea of "limits" being pertinent but applying more to the needs of individuals for material things than to the amounts of resources available to meet those needs; more durable production and provident consumption; and greater reliance on individual responsibility and action.

To conclude, a major challenge facing America over the next decade is to begin a massive and pervasive qualitative shift in the composition of economic activity. The social and value changes discussed in Chapter II and the shifts in technology and resource use described in Chapters V and VI may be expected to facilitate a movement toward a higher quality of growth, as growth requirements in the next decade and beyond are satisfied with less per-capita resource use, lower environmental impacts and expanded productivity.

The Need for a National Growth Policy

Numerous forces that will be shaping future U.S. economic growth have been highlighted in this report. Those which will adversely affect growth rates and patterns call for some form of remedial action, while others of a beneficial nature may require some degree of guidance to be fully effective. It has been demonstrated that the factors involved are not limited solely to economics but are multidisciplinary in nature. Yet Federal decisionmaking continues to suffer from a lack of integration within both the Executive and Legislative Branches. Problems are tackled in bits and pieces, often producing results favorable in one area but counterproductive in another. Another major shortcoming is a lack of foresight in anticipating problems. As Sterling Brubaker puts it in his recent book:

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[10] Edison Electric Institute, "Economic Growth in the Future," p. 254.

> The nation has no long-term strategy to guide short-term policy. It is easy to accept the idea that current policy should be consistent with a longer-term view, but this is difficult to achieve in the absence of agreement on what the longer-term options look like or which of them we choose.[11]

What is required, according to Brubaker, is a clearer public understanding of long term options, for this "favors a climate in which greater reconciliation between current policy and long-term goals is possible."

Certainly, shaping a higher quality of growth is very difficult in such a policy-making environment. It can only be achieved if the policy-making framework is better integrated and able to anticipate future needs.

But the coordination and the foresight problems stem largely from the fact that the United States has no clearly delineated goals to which policies are directed and by which progress assessments can be made. Eugen Loebel says "the most outstanding feature of our contemporary and mature mixed economy is the lack of any goal.[12] This, he feels, is a logical consequence of the way economics has developed. The concept of goals in economics has been eliminated by its frame of reference (the study of the allocation of resources and/or of economic laws and not the performance of the system in a normative sense). There is the claim that economics, as a science, has to be value free.

A major problem is that actions that make good sense to people initiating them, when added to those of other individuals, can add up to major social problems. A recent report by The Academy for Contemporary Problems, in a section entitled "Toward a Growth Policy," stated the argument for a growth policy in a nutshell:

> It appears reasonably certain, however, that unless some procedures are established to assist the nation to more clearly assess its options for future development and growth and unless some attempts are made to more clearly define these issues and to separate real questions from false ones, we are likely to continue to reap the consequences of "inadvertence"—accidental results flowing from public and private policies which may be defensible and reasonable on their specific merits but add up to undesirable outcomes when taken together.[13]

For all these reasons, highest priority should be given to establishment of a national growth policy. Its purpose would be to enable the Nation to anticipate the consequences of public and private actions for the quality of life more clearly than has been possible in the past. Such a policy would have to be based on the changing values and aspirations of the people. As McHale put it:

> There is a strong policy need to explore and survey, in more continuous fashion, such changes in citizen attitudes and preferences in relation to growth goals. This should also be done in ways that present more vividly the range of costs, benefits and options which changing directions would entail.[14]

An essential feature of a national growth policy, according to Harman and Thomas, is that it remain flexible. If the United States is entering a new era of economic growth in which more emphasis should be given to the quality of economic growth, then the decade ahead is

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[11] Sterling Brubaker. "In Command of Tomorrow," p. 1.
[12] Eugene Loebl, "Humanomics—How We Can Make The Economy Serve Us—Not Destroy Us," p. 137.
[13] David K. Hartley, Milton Patton, Ralph R. Widner, Kenneth D. Rainey, "A Reconnaissance of State and Local Approaches to the Problems of Growth," p. 3.
[14] McHale, p. 50.

a critical one for developing alternative policies which could help the economy adapt and to meet newly established goals. The word "alternative" must be stressed, since there will have to be much debate over what type of growth path will be best to provide the greatest increase in the quality of life for Americans.

In generating these alternative perceptions of the future or paths to meeting certain specific goals, it will be necessary to focus a great deal more attention on the supply side of the economy. Long-run supply problems are a largely undeveloped area which remains unmapped. It is hazardous to rely on market signals alone in generating reactions to resource scarcity. Not only are they often later in being sent than warnngs available from other sources, but also increasing population consuming more per capita than before is likely to result in shorter warning times.

The recent report of the Advisory Committee on National Growth Policy Processes summarizes these concerns succinctly:

> If we are to cope successfully with the complex and interrelated problems of the late twentieth century, it is imperative that we both improve the capacity of government to look into the future, anticipating problems instead of merely reacting to them, and also the ability of government to think comprehensively when preparing to make policy choices. . . . Overseeing the progress of a post-industrial society requires an accurate grasp not only of where we are but also of where we need to be and the merits of alternative ways of getting there.[15]

Russell Train, recognizing that nowhere in the Executive Branch is there any real capability for conducting the kind of continuing and comprehensive appraisal of the future that we must have if we are to ensure that the day-to-day decisions take us in the directions we want to go, emphasizes that it is "a matter of utmost importance" that we create such a capability within the national government.[16] Such a capability, he maintains, "should be institutionalized rather than simply utilized on an ad hoc basis." The question of what institution will house the responsibility for developing a flexible and changing national growth policy is critical.

John Kendrick testified that the rsponsibility for developing a continually adapting national growth policy should be given to a newly created body within the Office of the President. Unlike the Council of Economic Advisors, whose efforts are directed mainly toward the short run, this should be a group concerned primarily with long-run developments in the economy. The Advisory Committee on National Growth Policy Processes also felt that a new institutional arrangement was needed. Their report recommended that a National Growth and Development Commission be created as an independent agency in the Executive Branch. It's broad mandate would be to examine emerging issues of middle to long-range growth and to suggest feasible alternatives for the Congress, the President. and the public. They saw one of its primary functions to be to "raise the level of national debate on important issues by clearly setting forth policy choices, and in so doing, increase the sensitivity of elected leaders to the consquences of their action—or their inaction." [17]

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[15] Advisory Committee on National Growth Policy Processes, "Forging America's Future," p. 7.
[16] Russell E. Train, "Planning to Take Charge of Our Future," p. 59.
[17] Advisory Committee on National Growth Policy Processes, op. cit., p. 28.

The Advisory Committee also recommended a broadening of the President's Economic Report, giving equal weight to describing problems and proposing remedies. They felt it should present Presidential goals and policy plans in areas affecting national growth and development and at points of critical interaction among levels of government and between the private and public sectors. In general, it would give the President an occasion to "state more fully than he now does his views of the Nation's economic problems and opportunities, his proposals for dealing with them, and his vision of America's economic future and the means by which he would make that vision a reality." [18]

Besides the general public and the government, business will have to lend its support and help in the development of a national growth policy. Fortunately, many business leaders are coming to the realization that economic growth will have to be more closely monitored and guided than it has been in the past. In a recent poll of the Fortune 500 companies, a 64 percent median probability was placed on the view, "Business will be required by their own operating policies to consider the long-run view of how their decisions affect the overall quality of life." [19] Individual leaders have spoken out. Donald McNaughton, chairman of Prudential Insurance, has said that economic growth hardly makes sense if pursued in the old way while there is "an even worse imbalance between affluence and poverty, polluted air and water, dying cities, depletion of natural resources, and a massive growing pile of junk." [20] Because of this, he feels the time has come to recognize that the future role of business "must be social as well as economic." He joins with Thomas Clausen of the Bank of America in calling for a "social report" which will identify, assess and measure those elements of our national life that are essential to our well-being and which cannot be measured by present economic indices. Carl Madden views such ideas as a call by these business executives "for the extension of the concepts and methods of science to social affairs—and to the corporation as a social organization—which the intellectual revolution makes possible and which people are demanding." [21]

Thornton Bradshaw, President of Atlantic Richfield, feels that national planning is a necessity if government intervention into economic matters is to be more rational and if the market system is to be saved. He argues that such planning, which would include the setting of specific goals and plans for achieving them, would reduce the amount of government regulation with which we have to contend. As he sees it, national planning is "a process for assessing our economic condition and prospects, setting national goals and priorities, and then letting market forces work." [22] Thomas J. Watson, Jr., when chairman of IBM, also espoused goal setting in a planning context: "The complexity of our modern economy demands national goal setting and planning (which) should be costed and readjusted on an integrated basis just as a larger industrial enterprise sets and controls its goals." [23]

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[18] Ibid., p. 35.
[19] Jon Udell, Gene Laczniak, Robert F. Lusch, "The Business Environment of 1985," p. 46.
[20] Carl H. Madden, "Clash of Culture: Management in an Age of Changing Values," p. 77.
[21] Ibid.
[22] Thornton Bradshaw, "My Case for National Planning," p. 100.
[23] Neil Chamberlain, "Remaking American Values," p. 151.

Thus the Nation needs goals by which its performance can be judged just as much as individuals and corporations need them. The thrust of this developing consensus is captured quite well in the EEI report on growth:

> What is needed is a broader, more explicit, and more enlightened discussion of national goals and purposes. Without such a dialogue and a resulting commitment to some general course of public policy action, the Nation can only drift into an uncertain future. Such a process of nondecision and default would necessarily diminish the Nation's potential. The alternative is to foster and sustain a sense of national direction.[24]

This Nation has before it a fundamental choice. It can walk down the road into the future blindly, attacking crises as they arise with the traditional policy weapons. Or it can choose the exciting challenge to identify, explore and assess alternative paths to the future and to choose among them.

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[24] Edison Electric Institute, "Economic Growth in the Future," p. 23.

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APPENDIX

Measuring Economic Growth and Economic Welfare

In his paper for the Committee, F. Thomas Juster provided a comprehensive overview of the problems associated with measuring both economic growth and economic welfare.

He summarized the principal problems in measuring growth as follows:

(1) good measures of real economic depreciation of capital stock have not been available;

(2) the National Income Accounts are seriously inadequate in their treatment of capital stock in the form of natural resources;

(3) some forms of investment are not recognized at present in the ways the Accounts are kept, in particular, business outlays for research and development, consumer outlays for durable goods, and investments in human skills; and

(4) substantial sectors of the Accounts do not really measure output but instead reflect intermediate product "indicators" of output, a problem especially severe in the government sector.

Even if the present National Income and Product Accounts were substantially redesigned to become more accurate measures of economic growth, they still would be deficient as measures of economic welfare of the quality of life. Two kinds of deficiencies are those in measuring the flow of goods and services throughout the system and those of accounting for the welfare cost of excessive inequality in the distribution of goods and services among the population as well.

The first deficiency involves, for instance, the changing relative importance of the household and market sectors as producers of goods and services and developments in fringe benefits and conditions of work. On balance, the net effect of the shifts in the production of goods and services have been from the household to the market sector. Goods and services which once were provided mainly without compensation within the home, and thus made no measured contribution to output, are now being provided via the market and being included in measures of total output. Thus, some fraction of the gain in real output is illusory, resulting in overestimates of the rate of economic growth and the gain in economic welfare.

With regard to working conditions, Juster's principal point was that, on the whole, individuals are now employed under better working conditions and are probably more satisfied with them than they were earlier in the century. To the extent that this is true, "economic welfare has grown by appreciably more than the measured growth in output would suggest: changes in the physical characteristics of working conditions are counted as costs of output and not as output, while intrinsic satisfactions derived from work activities are clearly additive to the satisfactions derived from the income earned from working."[1]

Based on studies of preferences, two propositions emerge concerning income distribution:

(1) the optimum income distribution, as reflected by the preferences of the members of society, does not call for an equal distribution of resources among families;

(2) an optimum income distribution would provide a greater amount of resources to those at the low end of the income distribution, and somewhat less to those at the upper end of the income distribution, than presently appears to be the case.

Based on his conclusion that significant dimensions of both economic growth and economic welfare are basically perceptual rather than objective, and thus that no transformation or modification of the present structure of Accounts is able to incorporate these data, Juster suggested that measurement of economic growth and economic welfare would be best served by a combination of economic and social Accounts. He concludes:

[1] Juster, p. 20.

"There may be critical values—satisfactions above some minimum—without which overall welfare is perceived to be at low levels regardless of satisfactions with other aspects of life. If that is true, the appropriate policy calls for a greater focus on removing sources of illfare than on expanding resources of welfare." [2]

The new measure (or set of measures) must be fundamentally different from the present Accounts, as it must encompass many variables that are not primarily economic. Certainly, the developing field of social indicators has much to commend it. The Federal Government, however, should become more actively engaged in the development of such indicators. Such a concentrated effort, drawing upon innovative thinkers from many disciplines, is absolutely essential so that the country may better assess whether the quality of life for its citizens is indeed improving.

[2] Juster, p. 24.

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